US009230834B2

(12) **United States Patent**
Fukutomi et al.

(10) **Patent No.: US 9,230,834 B2**
(45) **Date of Patent: Jan. 5, 2016**

(54) **SUBSTRATE TREATING APPARATUS**

(75) Inventors: **Yoshiteru Fukutomi**, Kyoto (JP); **Tsuyoshi Mitsuhashi**, Kyoto (JP); **Hiroyuki Ogura**, Kyoto (JP); **Kenya Morinishi**, Kyoto (JP); **Yasuo Kawamatsu**, Kyoto (JP); **Hiromichi Nagashima**, Kyoto (JP)

(73) Assignee: **SCREEN Semiconductor Solutions Co., Ltd.**, Kyoto (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/401,617**

(22) Filed: **Feb. 21, 2012**

(65) **Prior Publication Data**

US 2012/0156380 A1 Jun. 21, 2012

Related U.S. Application Data

(63) Continuation of application No. 12/163,951, filed on Jun. 27, 2008, now Pat. No. 8,851,008.

(30) **Foreign Application Priority Data**

Jun. 29, 2007 (JP) 2007-172496

(51) **Int. Cl.**
B05D 3/12 (2006.01)
H01L 21/677 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H01L 21/67196*** (2013.01); ***H01L 21/6715*** (2013.01); ***H01L 21/67017*** (2013.01); ***H01L 21/67173*** (2013.01); ***H01L 21/67178*** (2013.01); ***H01L 21/67184*** (2013.01); ***H01L 21/67201*** (2013.01); *B05B 15/1259* (2013.01); *B05C 13/00* (2013.01); *B05D 3/0486* (2013.01); *H01L 21/67225* (2013.01); *H01L 23/34* (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H01L 21/6715; H01L 21/67161; H01L 1/67173; H01L 21/67178; H01L 21/67184; H01L 21/67225; G03F 7/162
USPC 427/240; 118/52; 430/434; 438/780, 438/782
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,409,889	A	10/1983	Burleson
4,985,722	A	1/1991	Ushijima et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN	1773672	5/2006
JP	H01-241840 A1	9/1989

(Continued)

OTHER PUBLICATIONS

Machine translation of KR 10-2006-0033423 A, published Apr. 19, 2006.*

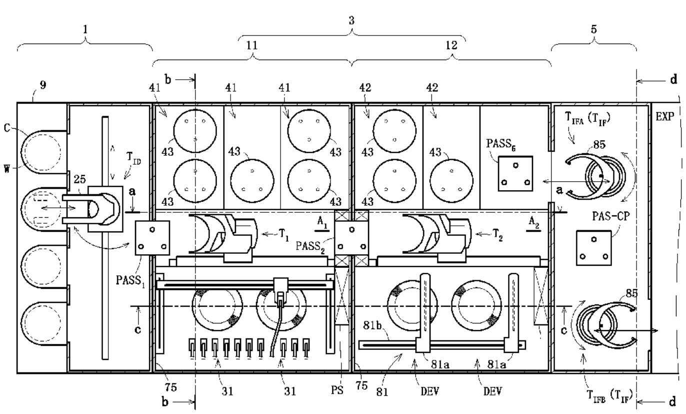
(Continued)

Primary Examiner — Kirsten Jolley
(74) *Attorney, Agent, or Firm* — Kilpatrick Townsend & Stockton LLP

(57) **ABSTRACT**

A substrate treating method for treating substrates with a substrate treating apparatus having an indexer section, a treating section and an interface section includes performing resist film forming treatment in parallel on a plurality of stories provided in the treating section and performing developing treatment in parallel on a plurality of stories provided in the treating section.

19 Claims, 12 Drawing Sheets



(51) **Int. Cl.**

H01L 21/67	(2006.01)
B05C 13/00	(2006.01)
B05D 3/04	(2006.01)
B05B 15/12	(2006.01)
H01L 23/34	(2006.01)

(52) **U.S. Cl.**
CPC *H01L 2924/0002* (2013.01); *Y10S 414/135* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,028,195	A	7/1991	Ishii et al.
5,100,516	A	3/1992	Nishimura et al.
5,102,283	A	4/1992	Balzola Elorza
5,177,514	A	1/1993	Ushijima et al.
5,202,716	A	4/1993	Tateyama et al.
5,275,709	A	1/1994	Anderle et al.
5,297,910	A	3/1994	Yoshioka et al.
5,430,271	A	7/1995	Orgami et al.
5,518,542	A	5/1996	Matsukawa et al.
5,536,128	A	7/1996	Shimoyashiro et al.
5,565,034	A	10/1996	Nanbu et al.
5,571,325	A	11/1996	Ueyama et al.
5,651,823	A	7/1997	Parodi et al.
5,664,254	A	9/1997	Ohkura et al.
5,668,056	A	9/1997	Wu et al.
5,668,733	A	9/1997	Morimoto et al.
5,672,205	A	9/1997	Fujimoto et al.
5,677,758	A	10/1997	McEachern et al.
5,725,664	A	3/1998	Nanbu et al.
5,788,447	A	8/1998	Yonemitsu et al.
5,788,868	A	8/1998	Itaba et al.
5,803,932	A	9/1998	Akimoto et al.
5,820,679	A	10/1998	Yokoyama et al.
5,826,129	A	10/1998	Hasebe et al.
5,842,917	A	12/1998	Soung et al.
5,844,662	A	12/1998	Akimoto et al.
5,858,863	A	1/1999	Yokoyama et al.
5,876,280	A	3/1999	Kitano et al.
5,928,390	A	7/1999	Yaeggashi et al.
5,937,223	A	8/1999	Akimoto et al.
5,963,753	A	10/1999	Ohtani et al.
5,972,110	A	10/1999	Akimoto
5,976,199	A	11/1999	Wu et al.
6,007,629	A	12/1999	Ohtani et al.
6,010,570	A	1/2000	Motoda et al.
6,027,262	A	2/2000	Akimoto
6,062,798	A	5/2000	Muka
6,063,439	A	5/2000	Semba et al.
6,099,598	A	8/2000	Yokoyama et al.
6,099,643	A	8/2000	Ohtani et al.
6,116,841	A	9/2000	Iwasaki
6,146,083	A	11/2000	Iwasaki
6,151,981	A	11/2000	Costa
6,161,969	A	12/2000	Kimura et al.
6,176,667	B1	1/2001	Fairbairn et al.
6,210,481	B1	4/2001	Sakai et al.
6,227,786	B1	5/2001	Tateyama
6,235,634	B1	5/2001	White et al.
6,264,748	B1	7/2001	Kuriki et al.
6,266,125	B1	7/2001	Fukuda et al.
6,270,306	B1	8/2001	Otwell et al.
6,287,023	B1	9/2001	Yaegashi et al.
6,287,025	B1	9/2001	Matsuyama
6,290,405	B1	9/2001	Ueda
6,333,003	B1	12/2001	Katano et al.
6,338,582	B1	1/2002	Ueda
6,377,329	B1	4/2002	Takekuma
6,382,895	B1	5/2002	Konishi et al.
6,402,401	B1	6/2002	Ueda et al.
6,426,303	B1	7/2002	Ueda
6,432,842	B2	8/2002	Akimoto et al.
6,444,029	B1	9/2002	Kimura et al.
6,454,472	B1	9/2002	Kim et al.
6,461,438	B1	10/2002	Ookura et al.
6,464,789	B1	10/2002	Akimoto
6,466,300	B1	10/2002	Deguchi
6,485,203	B2	11/2002	Katano et al.
6,491,451	B1	12/2002	Stanley et al.
6,511,315	B2	1/2003	Hashimoto
6,537,835	B2	3/2003	Adachi et al.
6,558,053	B2	5/2003	Shigemori et al.
6,590,634	B1	7/2003	Nishi et al.
6,680,775	B1	1/2004	Hirikawa
6,698,944	B2	3/2004	Fujita
6,750,155	B2	6/2004	Halsey et al.
6,752,543	B2	6/2004	Fukutomi et al.
6,752,872	B2	6/2004	Inada et al.
6,758,647	B2	7/2004	Kaji et al.
6,807,455	B2	10/2004	Yoshida et al.
6,832,863	B2	12/2004	Sugimoto et al.
6,879,866	B2	4/2005	Tel et al.
6,889,014	B2	5/2005	Takano
6,893,171	B2	5/2005	Fukutomi et al.
6,910,497	B2	6/2005	Bernard
6,919,001	B2	7/2005	Fairbairn et al.
6,937,917	B2	8/2005	Akiyama et al.
6,955,595	B2	10/2005	Kim
6,982,102	B2	1/2006	Inada et al.
7,001,674	B2	2/2006	Irie
7,008,124	B2	3/2006	Miyata
7,017,658	B2	3/2006	Hisai et al.
7,053,990	B2	5/2006	Galburt et al.
7,069,099	B2	6/2006	Hashinoki et al.
7,072,730	B2	7/2006	Kobayashi et al.
7,241,061	B2	7/2007	Akimoto et al.
7,245,348	B2	7/2007	Akimoto et al.
7,262,829	B2	8/2007	Hayashida et al.
7,279,067	B2	10/2007	Yoshida et al.
7,281,869	B2	10/2007	Akimoto et al.
7,317,961	B2	1/2008	Hashinoki et al.
7,322,756	B2	1/2008	Akimoto et al.
7,323,060	B2	1/2008	Yamada et al.
7,335,090	B2	2/2008	Takahashi
7,497,633	B2	3/2009	Kaneyama et al.
7,522,823	B2	4/2009	Fukumoto et al.
7,525,650	B2	4/2009	Shiga et al.
7,537,401	B2	5/2009	Kim et al.
7,549,811	B2	6/2009	Yamada et al.
7,563,042	B2	7/2009	Nakaharada et al.
7,604,424	B2	10/2009	Shigemori et al.
7,641,405	B2	1/2010	Fukutomi
7,641,406	B2	1/2010	Nishimura et al.
7,645,081	B2	1/2010	Hara et al.
7,651,306	B2	1/2010	Rice et al.
7,652,276	B2	1/2010	Hayakawa et al.
7,661,894	B2	2/2010	Matsuoka et al.
7,675,048	B2	3/2010	Binns et al.
7,686,559	B2	3/2010	Tsujimoto et al.
7,692,764	B2	4/2010	Shirata
7,699,021	B2	4/2010	Volfovski et al.
7,729,798	B2	6/2010	Hayashida et al.
7,758,341	B2	7/2010	Dong-Hun
7,801,633	B2	9/2010	Yamamoto et al.
7,809,460	B2	10/2010	Ishida et al.
7,819,079	B2	10/2010	Englhardt et al.
7,836,845	B2	11/2010	Tanoue et al.
7,841,072	B2	11/2010	Matsuoka et al.
7,871,211	B2	1/2011	Matsuoka et al.
7,905,668	B2	3/2011	Yamamoto
7,925,377	B2	4/2011	Ishikawa et al.
7,934,880	B2	5/2011	Hara et al.
8,025,023	B2	9/2011	Hayashida et al.
8,034,190	B2	10/2011	Yasuda et al.
8,113,141	B2	2/2012	Oh
8,113,142	B2	2/2012	Oh
8,154,106	B2	4/2012	Ishida et al.
8,220,354	B2	7/2012	Todorov
8,268,384	B2	9/2012	Matshuoka et al.
8,289,496	B2	10/2012	Kim et al.
8,342,761	B2	1/2013	Matsuoka
8,353,986	B2	1/2013	Sasaski et al.
8,419,341	B2	4/2013	Hoey et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,443,513	B2	5/2013	Ishida et al.
8,480,319	B2	7/2013	Hayashi et al.
8,545,118	B2	10/2013	Ogura et al.
8,560,108	B2	10/2013	Matsuyana et al.
8,588,950	B2	11/2013	Nomura
8,612,807	B2	12/2013	Collins, Jr.
8,631,809	B2	1/2014	Hamada et al.
8,708,587	B2	4/2014	Ogura et al.
8,731,701	B2	5/2014	Tsukinoki et al.
8,851,008	B2	10/2014	Fukutomi et al.
2001/0013161	A1	8/2001	Kitano et al.
2001/0013515	A1	8/2001	Harada et al.
2001/0031147	A1	10/2001	Takamori et al.
2002/0011207	A1	1/2002	Uzawa et al.
2002/0048509	A1	4/2002	Sakata et al.
2002/0053319	A1	5/2002	Nagamine
2003/0079957	A1	5/2003	Otaguro et al.
2003/0098966	A1	5/2003	Korenaga et al.
2003/0131458	A1	7/2003	Wang et al.
2003/0147643	A1	8/2003	Miyata et al.
2003/0213431	A1	11/2003	Fukutomi et al.
2003/0216053	A1	11/2003	Miyata
2004/0005149	A1	1/2004	Sugimoto et al.
2004/0007176	A1	1/2004	Janakiraman et al.
2004/0050321	A1	3/2004	Kitano et al.
2004/0061065	A1	4/2004	Hashimoto et al.
2004/0122545	A1	6/2004	Akiyama et al.
2004/0182318	A1	9/2004	Hashinoki et al.
2004/0229441	A1	11/2004	Sugimoto et al.
2005/0030511	A1	2/2005	Auer-Jongepier et al.
2005/0042555	A1	2/2005	Matsushita et al.
2005/0061441	A1	3/2005	Hashinoki et al.
2005/0069400	A1	3/2005	Dickey et al.
2005/0135905	A1	6/2005	Moriya et al.
2005/0266323	A1	12/2005	Raulea
2006/0011296	A1	1/2006	Higashi et al.
2006/0024446	A1	2/2006	Sugimoto et al.
2006/0028630	A1	2/2006	Akimoto
2006/0062282	A1	3/2006	Wright
2006/0090849	A1	5/2006	Toyoda et al.
2006/0098978	A1	5/2006	Yasuda et al.
2006/0104635	A1	5/2006	Kaneyama et al.
2006/0134330	A1	6/2006	Ishikawa et al.
2006/0137726	A1	6/2006	Sano et al.
2006/0147202	A1	7/2006	Yasuda et al.
2006/0162858	A1	7/2006	Akimoto et al.
2006/0194445	A1	8/2006	Hayashi et al.
2006/0201423	A1	9/2006	Akimoto et al.
2006/0201615	A1	9/2006	Matsuoka et al.
2006/0219171	A1	10/2006	Sasaki et al.
2006/0286300	A1	12/2006	Ishikawa et al.
2007/0048979	A1	3/2007	Fukuoka et al.
2007/0056514	A1	3/2007	Akimoto et al.
2007/0058147	A1	3/2007	Hamada
2007/0128529	A1	6/2007	Kazaana
2007/0172234	A1	7/2007	Shigemori et al.
2007/0179658	A1	8/2007	Hamada
2007/0190437	A1	8/2007	Kaneyama et al.
2007/0219660	A1	9/2007	Kaneko et al.
2007/0274711	A1	11/2007	Kaneyama et al.
2007/0280680	A1	12/2007	Kim et al.
2007/0297794	A1	12/2007	Park et al.
2008/0014333	A1	1/2008	Matsuoka et al.
2008/0026153	A1	1/2008	Hayashida et al.
2008/0037013	A1	2/2008	Yamamoto et al.
2008/0070164	A1	3/2008	Hayashida et al.
2008/0129968	A1	6/2008	Hayashida et al.
2008/0158531	A1	7/2008	Kiuchi
2008/0212049	A1	9/2008	Fukutomi et al.
2008/0224817	A1	9/2008	Vellore et al.
2008/0269937	A1	10/2008	Yamamoto
2008/0304940	A1	12/2008	Auer-Jongepier et al.
2009/0000543	A1	1/2009	Fukutomi et al.
2009/0001071	A1	1/2009	Kulkarni
2009/0014126	A1	1/2009	Ohtani et al.
2009/0018686	A1	1/2009	Yamamoto et al.
2009/0044747	A1	2/2009	Nishimura
2009/0060480	A1	3/2009	Herchen
2009/0070946	A1	3/2009	Tamada et al.
2009/0098298	A1	4/2009	Miyata et al.
2009/0139450	A1	6/2009	Ogura et al.
2009/0139833	A1	6/2009	Ogura
2009/0142162	A1	6/2009	Ogura et al.
2009/0142713	A1	6/2009	Yamamoto
2009/0143903	A1	6/2009	Blust et al.
2009/0149982	A1	6/2009	Higashi et al.
2009/0165711	A1	7/2009	Ogura et al.
2009/0165712	A1	7/2009	Ogura et al.
2009/0165950	A1	7/2009	Kim et al.
2009/0247053	A1	10/2009	Lee
2009/0291558	A1	11/2009	Kim et al.
2010/0050940	A1	3/2010	Sahoda et al.
2010/0061718	A1	3/2010	Hara et al.
2010/0126527	A1	5/2010	Hamada
2010/0136257	A1	6/2010	Yasuda et al.
2010/0183807	A1	7/2010	Kim
2010/0191362	A1	7/2010	Tsukinoki
2010/0192844	A1	8/2010	Kim et al.
2010/0195066	A1	8/2010	Kim et al.
2011/0043773	A1	2/2011	Matsuoka
2011/0063588	A1	3/2011	Kashiyama et al.
2011/0078898	A1	4/2011	Ishida et al.
2011/0082579	A1	4/2011	Yoshida et al.
2011/0208344	A1	8/2011	Matsuyama et al.
2011/0211825	A1	9/2011	Matsuoka et al.
2011/0242508	A1	10/2011	Kobayashi
2011/0276166	A1	11/2011	Atanasoff
2011/0297085	A1	12/2011	Matsuyama et al.
2012/0013730	A1	1/2012	Koga
2012/0013859	A1	1/2012	Matsuoka et al.
2012/0015307	A1	1/2012	Matsuoka et al.
2012/0029687	A1	2/2012	Hagen et al.
2012/0073461	A1	3/2012	Terada et al.
2012/0084059	A1	4/2012	Akada
2012/0086142	A1	4/2012	Terada et al.
2012/0097336	A1	4/2012	Terada et al.
2012/0135148	A1	5/2012	Deguchi et al.
2012/0145073	A1	6/2012	Fukutomi et al.
2012/0145074	A1	6/2012	Fukutomi et al.
2012/0271444	A1	10/2012	Matsumoto
2012/0307217	A1	12/2012	Kim et al.
2014/0000514	A1	1/2014	Ogura et al.
2014/0003891	A1	1/2014	Kobayashi
2014/0152966	A1	6/2014	Hwang et al.
2014/0342558	A1	11/2014	Ogura et al.

FOREIGN PATENT DOCUMENTS

JP	H04-085812	A1	3/1992
JP	H-085812	A1	3/1992
JP	H06-5689	A1	1/1994
JP	H06-89934	A1	3/1994
JP	H07-283094	A1	10/1995
JP	H08-162514	A1	6/1996
JP	H09-045613	A1	2/1997
JP	H9-148240	A1	6/1997
JP	09-199568		7/1997
JP	H09-251953	A1	9/1997
JP	09-312323	A1	12/1997
JP	H10-50794	A1	2/1998
JP	H10-74822	A1	3/1998
JP	H10-144673	A1	5/1998
JP	10-146744	A1	6/1998
JP	10-209241		7/1998
JP	H10-189420	A1	7/1998
JP	H10-261689	A1	9/1998
JP	H10-294351	A1	11/1998
JP	H10-335415	A1	12/1998
JP	H11-3581	A	6/1999
JP	H11-251405	A1	9/1999
JP	11-340301	A	12/1999
JP	2000-012443	A1	1/2000
JP	2000-049089	A1	2/2000
JP	2000-100886	A1	4/2000

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2000-124124	A1	4/2000
JP	2000-124129	A1	4/2000
JP	2000-200822	A1	7/2000
JP	H11-16978	A1	7/2000
JP	2000-269297	A1	9/2000
JP	2000-331922		11/2000
JP	2001-093827	A1	6/2001
JP	2001-176792	A1	6/2001
JP	03-211749	A	9/2001
JP	2002-510141	A1	2/2002
JP	2003-059810	A1	2/2003
JP	2003-224175	A1	8/2003
JP	2003-309160	A1	10/2003
JP	2003-324059	A1	11/2003
JP	2003-324139		11/2003
JP	2003-338496	A1	11/2003
JP	2004-15021	A1	1/2004
JP	2004-015023	A1	1/2004
JP	2004-31921	A1	1/2004
JP	2004-087675		3/2004
JP	2004-046450		5/2004
JP	2004-152801	A1	5/2004
JP	2004-193597	A	7/2004
JP	2004-200485	A1	7/2004
JP	2004-207279	A1	7/2004
JP	2004-241319	A1	8/2004
JP	2004-260129		9/2004
JP	3600711		9/2004
JP	2004-304003	A1	10/2004
JP	2004-311714	A1	11/2004
JP	2004-319767	A1	11/2004
JP	2005-57294	A1	3/2005
JP	2005-093920	A1	4/2005
JP	2005-101078	A1	4/2005
JP	2005-123249	A1	5/2005
JP	2005-167083	A1	6/2005
JP	2005-243690	A1	9/2005
JP	2006-203075		8/2006
JP	2006-216614	A1	8/2006
JP	2006-228974	A1	8/2006
JP	2006-229183	A1	8/2006
JP	2006-245312		9/2006
JP	2006-253501	A1	9/2006
JP	2006-269672	A1	10/2006
JP	2006-287178	A1	10/2006
JP	2006-335484	A1	12/2006
JP	2007-005659	A1	1/2007
JP	2007-288029	A1	1/2007
JP	2007-067178	A1	3/2007
JP	2007-150071	A1	6/2007
JP	2007-158260	A1	6/2007
JP	2007-208064	A1	8/2007
JP	2007-227984		9/2007
JP	2007-287887	A1	11/2007
JP	2009-99577	A1	5/2009
JP	2009-164256	A1	7/2009
JP	2009-076893	A1	9/2009
KR	1997-0011065	A1	3/1997
KR	1999-0023624	A	3/1999
KR	2001-0029862	A	4/2001
KR	2002-0035758	A1	5/2002
KR	10-0387418	B1	6/2003
KR	10-2003-0087417	A	11/2003
KR	2003-0086900	A	11/2003
KR	10-2004-0054517	A	6/2004
KR	1020050049935	A1	5/2005
KR	10-2005-0051280	A	6/2005
KR	10-2006-0033423	A	4/2006
KR	10-2006-0088495	A	4/2006
KR	2006-0050112	A	5/2006
KR	10-2006-0085188	A	7/2006
KR	10-2006-0088495	A	8/2006
KR	10-2006-0092061	A	8/2006
KR	10-2006-0097613	A	9/2006
KR	10-0634122	B1	10/2006
KR	10-2007-0007262	A	1/2007
KR	2007-0003328	A	1/2007
KR	10-0698352	A	3/2007
KR	10-2007-062522	A	6/2007
TW	200631680		9/2006

OTHER PUBLICATIONS

English translation of JP 10-2006-0033423, published Apr. 2006.*

Notice of Allowance for U.S. Appl. No. 12/324,794 mailed May 29, 2013, 7 pages.

Non-Final Office Action for U.S. Appl. No. 13/401,644 mailed Jun. 21, 2013, 16 pages.

Office Action for corresponding Chinese Application No. 20081010225036.7 dated Sep. 18, 2009, 4 pages.

Office Action for corresponding Korean Application No. 10-2008-0060084 dated Mar. 9, 2010, 5 pages.

Notice of Allowance of Korean Application No. 10-2008-0118967 dated Oct. 21, 2010, 2 pages total.

Office Action for corresponding Korean Application No. 10-2008-0132304 mailed Oct. 25, 2010, 4 pages.

Office Action for corresponding Korean Application No. 10-2008-0132009 dated Jan. 18, 2011, 5 pages.

Invalidation Trial for corresponding Korean Patent No. 10-1001511 received on Apr. 13, 2011, 53 pages.

Notice of Allowance for corresponding Korean application No. 10-2010-0105888 dated Apr. 22, 2011, 3 pages.

Invalidation Trial for corresponding Korean Application No. 10-1010086 dated Apr. 25, 2011, 68 pages.

Office Action for corresponding Korean Application No. 10-2008-0132009 dated Jul. 21, 2011, 5 pages.

Office Action for corresponding Japanese Application No. 2007-172496 dated Sep. 27, 2011, 4 pages.

Invalidation Trial for corresponding Korean Patent No. 10-1036420 received on Sep. 27, 2011, 36 pages.

Office Action for corresponding Japanese Application No. 2007-340427 dated Oct. 4, 2011, 2 pages.

Office Action for corresponding Japanese Application No. 2007-340428 dated Oct. 4, 2011, 2 pages.

Invalidation Trial for corresponding Korean Patent No. 10-1047799 (Korean Patent application No. 10-2008-132304) received on Nov. 16, 2011, 69 pages.

Office Action for corresponding Japanese Application No. 2008-076610 dated Jan. 10, 2012, 2 pages.

Office Action for corresponding Japanese Application No. 2008-076611 dated Jan. 10, 2012.

Office Action for corresponding Japanese Application No. 2008-076608 dated Jan. 17, 2012, 4 pages.

Office Action for corresponding Taiwanese Application No. 097150911 dated Apr. 10, 2012, 6 pages.

Office Action for corresponding Japanese Application No. 2007-340428 dated Apr. 24, 2012, 3 pages.

Office Action for corresponding Japanese Application No. 2007-310676 dated May 8, 2012, 3 pages.

Office Action for corresponding Japanese Application No. 2007-310677 dated May 8, 2012, 4 pages.

Non-Final Office Action for U.S. Appl. No. 12/324,788 mailed May 27, 2011, 41 pages.

Non-Final Office Action for U.S. Appl. No. 12/163,951 mailed Jul. 11, 2011, 18 pages.

Non-Final Office Action for U.S. Appl. No. 12/343,302 mailed Aug. 19, 2011, 26 pages.

Non-Final Office Action for U.S. Appl. No. 12/324,802 mailed Sep. 14, 2011, 13 pages.

Non-Final Office Action for U.S. Appl. No. 12/343,292 mailed Oct. 28, 2011, 12 pages.

Final Office Action for U.S. Appl. No. 12/324,788 mailed Dec. 7, 2011, 26 pages.

Final Office Action for U.S. Appl. No. 12/163,951 mailed Jan. 19, 2012, 22 pages.

Non-Final Office Action for U.S. Appl. No. 12/324,794 mailed Feb. 3, 2012, 8 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Final Office Action for U.S. Appl. No. 12/343,302 mailed Apr. 12, 2012, 33 pages.
Final Office Action for U.S. Appl. No. 12/324,802 mailed Apr. 20, 2012, 14 pages.
Final Office Action for U.S. Appl. No. 12/343,292 mailed Jun. 1, 2012, 15 pages.
Office Action for corresponding Taiwanese Application No. 097150912 dated Jun. 1, 2012, 6 pages.
Notice of Allowance for corresponding Korean Patent Application No. 10-2008-0132009 dated Jun. 22, 2012, 3 pages.
Office Action for corresponding Japanese Patent Application No. 2008-327897 dated Nov. 6, 2012, 4 pages.
Office Action for corresponding Japanese Patent Application No. 2007-340430 dated Dec. 18, 2012, 3 pages.
Information Statement for corresponding Japanese Patent Application No. 2007-310676 dated Jan. 15, 2013, 4 pages.
Non-Final Office Action for U.S. Appl. No. 13/401,625 mailed Mar. 14, 2013, 8 pages.
Office Action for corresponding Japanese Application No. 2007-310675 dated Jul. 31, 2012, 3 pages.
Decision of Patent for corresponding Japanese Application No. 2007-310677 dated Oct. 16, 2012, 3 pages.
Advisory Action for U.S. Appl. No. 12/343,292 mailed Oct. 12, 2012, 3 pages.
Office Action for corresponding Japanese Patent Application No. 2011-265835 dated Apr. 23, 2013, 3 pages.
Office Action for corresponding Korean Patent Application No. 10-2012-0005204 dated Nov. 1, 2012, 6 pages.
Notice of Allowance for corresponding Korean Patent Application No. 10-2012-0005204 dated Jan. 22, 2014, 3 pages.
Final Office Action for U.S. Appl. No. 13/401,644 mailed Nov. 22, 2013, 20 pages.
Restriction Requirement for U.S. Appl. No. 12/163,951 mailed Feb. 3, 2014, 7 pages.
Non-Final Office Action for U.S. Appl. No. 13/401,625 mailed on Mar. 28, 2014, 11 pages.
Supplemental Notice of Allowance for U.S. Appl. No. 14/011,993 mailed on Apr. 1, 2014, 2 pages.
Non-Final Office Action for U.S. Appl. No. 13/401,644 mailed on Apr. 4, 2014, 10 pages.
Non-Final Office Action for U.S. Appl. No. 12/324,788 mailed on Apr. 4, 2014, 30 pages.
Non-Final Office Action for U.S. Appl. No. 12/324,802 mailed on Apr. 7, 2014, 17 pages.
Non-Final Office Action for U.S. Appl. No. 12/343,302 mailed on Apr. 10, 2014, 22 pages.
Restriction Requirement for U.S. Appl. No. 12/343,292 mailed on Apr. 10, 2014, 6 pages.
Office Action for corresponding Japanese Patent Application No. 2011-257538, dated Dec. 3, 2013, 3 pages.
Invalidation Trial for corresponding Korean Patent No. 10-1276946, dated Nov. 12, 2013, 52 pages.
Argument in the Trial for Patent Invalidation for corresponding Korean Patent No. 10-1170211 dated Feb. 27, 2014, 21 pages.
Invalidation Trial for corresponding Korean Patent No. 10-1170211 dated Aug. 7, 2013, 26 pages.
U.S. Appl. No. 14/011,993, filed Aug. 28, 2013 by Ogura et al.
Final Office Action for U.S. Appl. No. 13/401,625 mailed Sep. 19, 2013, 11 pages.
Office Action for corresponding Japanese Patent Application No. 2012-118584 dated Oct. 22, 2013, 2 pages.
Notice of Allowance for U.S. Appl. No. 14/011,993 mailed Oct. 7, 2013, 11 pages.
Argument in the Trial for Patent Invalidation for corresponding Korean Patent No. 10-1213284, dated Dec. 20, 2013, 19 pages.
Argument in the Trial for Patent Invalidation for corresponding Korean Patent No. 10-1276946 dated May 28, 2014, 45 pages.
Information Statement for corresponding Japanese Patent Application No. 2012-118583 dated May 16, 2014, 22 pages.
Office Action for corresponding Japanese Patent Application No. 2012-118583 dated Jun. 24, 2014, 2 pages.
Notice of Allowance for U.S. Appl. No. 12/163,951 mailed on Jul. 10, 2014, 9 pages.
Invalidation Trial for corresponding Korean Patent No. 10-1213284 dated Jul. 3, 2013, 31 pages.
Invalidation trial for corresponding Taiwanese Patent No. 97124376 dated Jul. 30, 2013, 43 pages.
Trial Decision for corresponding Korean Patent No. 10-1047799 dated Jun. 25, 2013, 125 pages.
Office Action for corresponding Japanese Patent Application No. 2012-118585 dated Jun. 25, 2013, 3 pages.
Office Action for corresponding Japanese Patent Application No. 2011-257538 dated Jul. 2, 2013, 3 pages.
U.S. Appl. No. 14/447,409, filed Jul. 30, 2014 by Ogura et al.
Final Office Action for U.S. Appl. No. 12/324,802 mailed on Oct. 22, 2014, 24 pages.
Final Office Action for U.S. Appl. No. 12/343,292 mailed on Nov. 5, 2014, 20 pages.
Final Office Action for U.S. Appl. No. 12/324,788 mailed on Nov. 6, 2014, 44 pages.
Final Office Action for U.S. Appl. No. 13/401,644 mailed on Dec. 1, 2014, 20 pages.
Non-Final Office Action for U.S. Appl. No. 12/343,292 mailed on Jun. 3, 2015, 25 pages.
Notice of Allowance for U.S. Appl. No. 13/401,625 mailed on Jun. 16, 2015, 15 pages.
Notice of Allowance for U.S. Appl. No. 12/324,802 mailed on Jun. 26, 2015, 20 pages.
Notice of Allowance for U.S. Appl. No. 13/401,644 mailed on Jun. 29, 2015, 15 pages.
Trial for Patent Invalidation for corresponding Korean Patent Application No. 10-1432358, dated May 22, 2015, 60 pages.
Non-Final Office Action for U.S. Appl. No. 13/401,625 mailed on Dec. 9, 2014, 16 pages.
Trial for Patent Invalidation for corresponding Korean Patent Application No. 10-1432358 dated Nov. 18, 2014, 54 pages.
Office Action for corresponding Taiwanese Patent Application No. 101118484 dated Feb. 26, 2015, 15 pages.

* cited by examiner

Fig.1

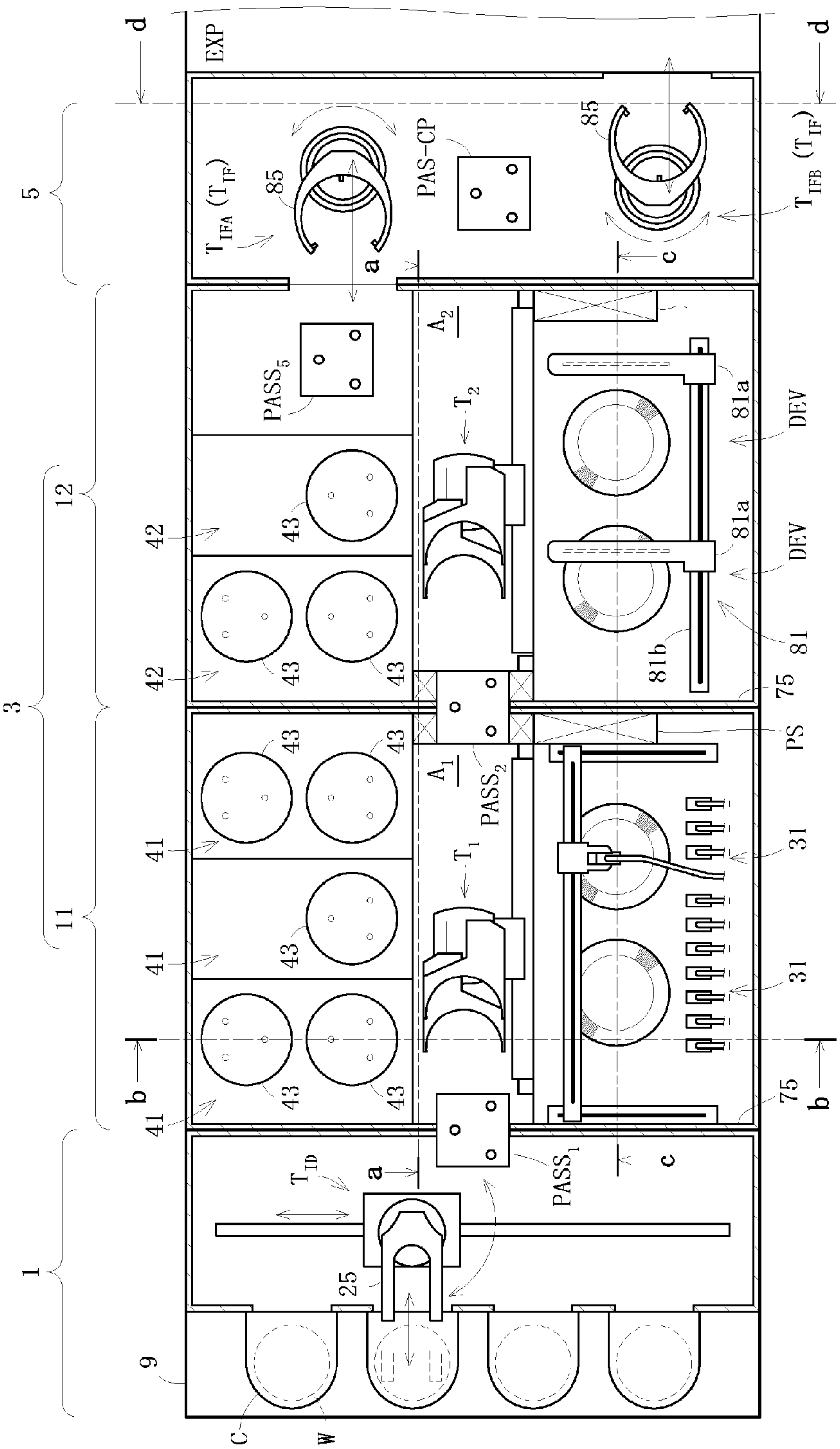

EXP
d
5
T_{IFA} (T_{IF})
85
PAS-CP
a
c
T_{IFB} (T_{IF})
12
3
11
1
$PASS_5$
$PASS_2$
$PASS_1$
42
43
41
T_2
T_1
T_{ID}
A_2
A_1
81a
81b
81
DEV
75
PS
31
b
25
9
C
W

Fig.2

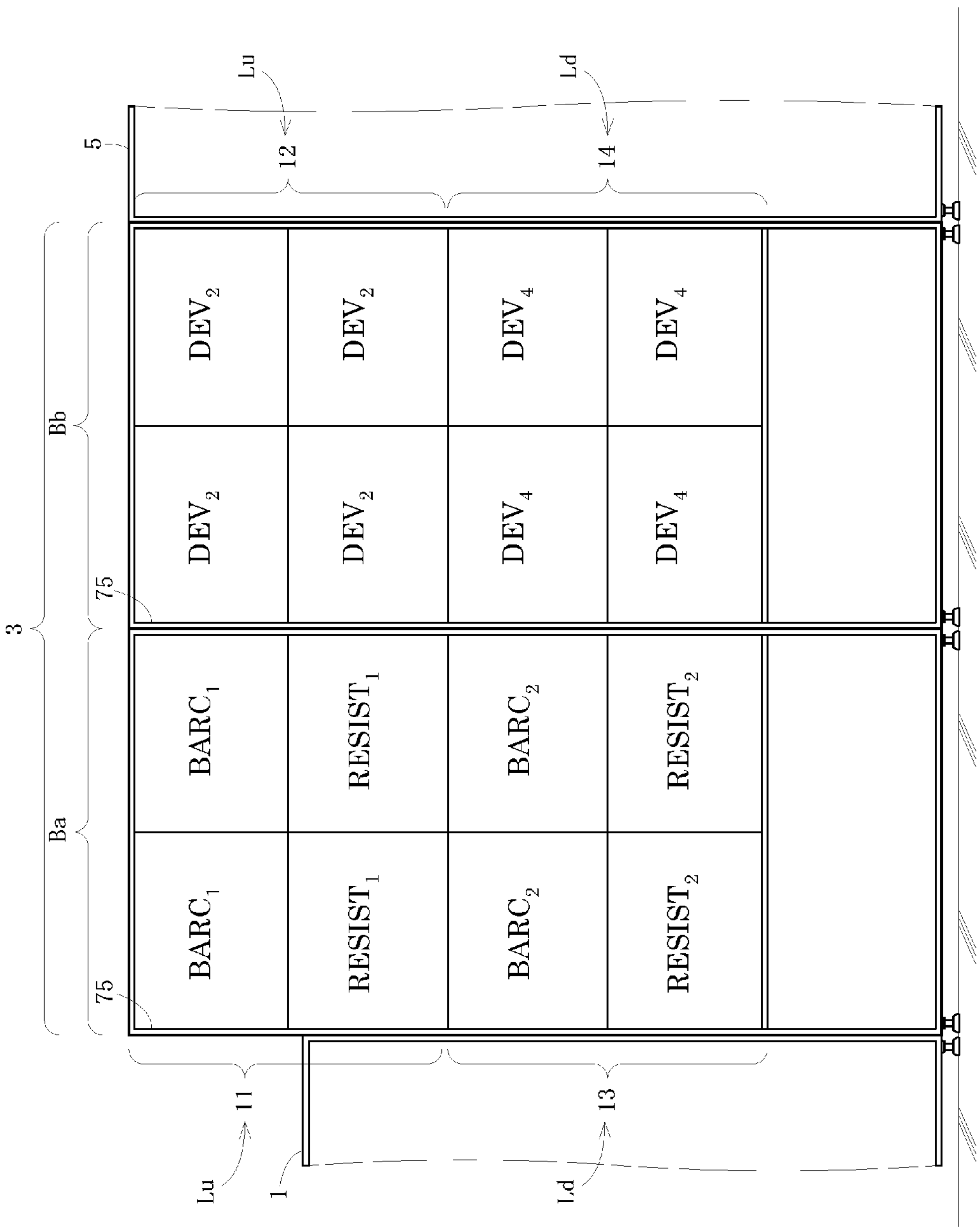

DEV2
DEV4
BARC1
RESIST1
BARC2
RESIST2
Lu
Ld
1
3
5
11
12
13
14
75
Ba
Bb

Fig.3

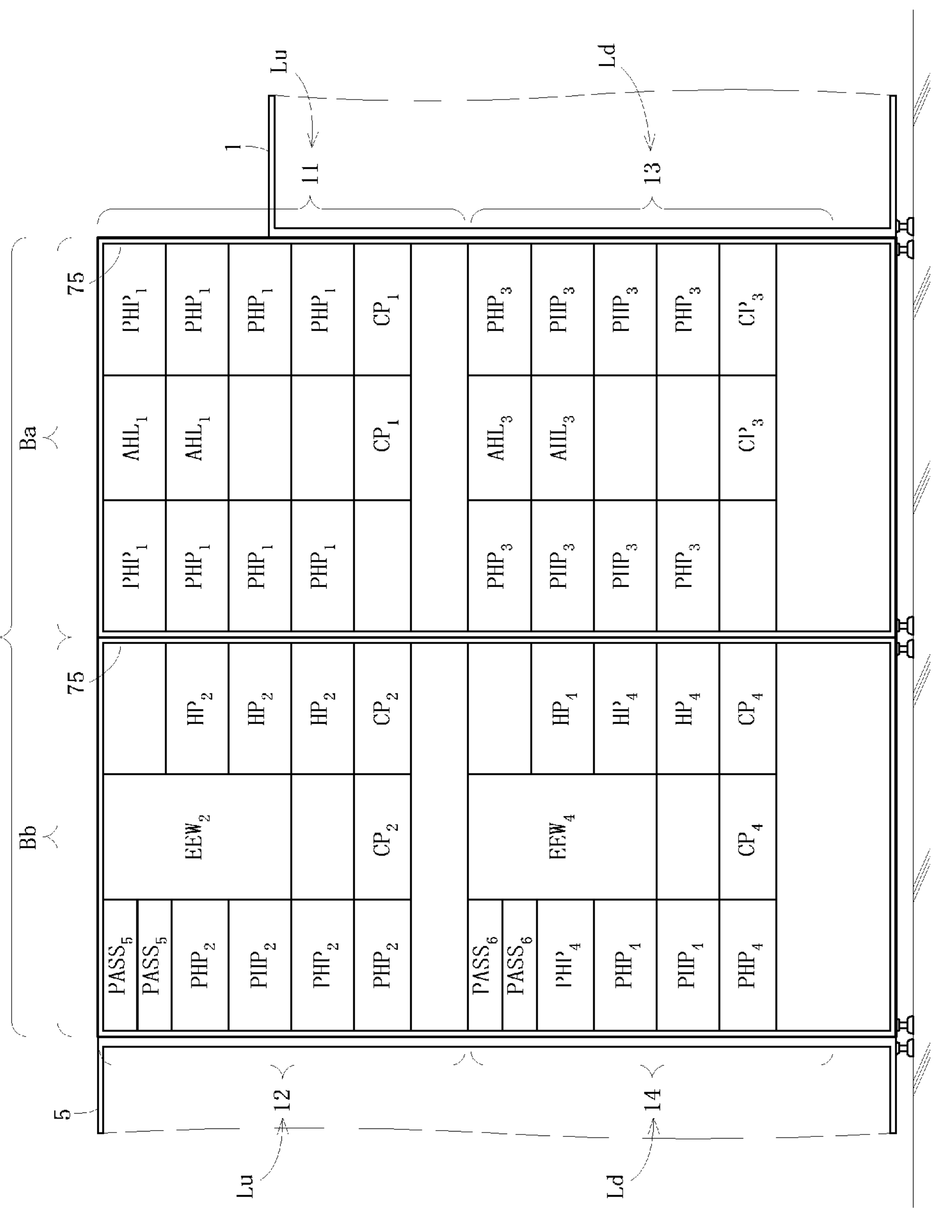
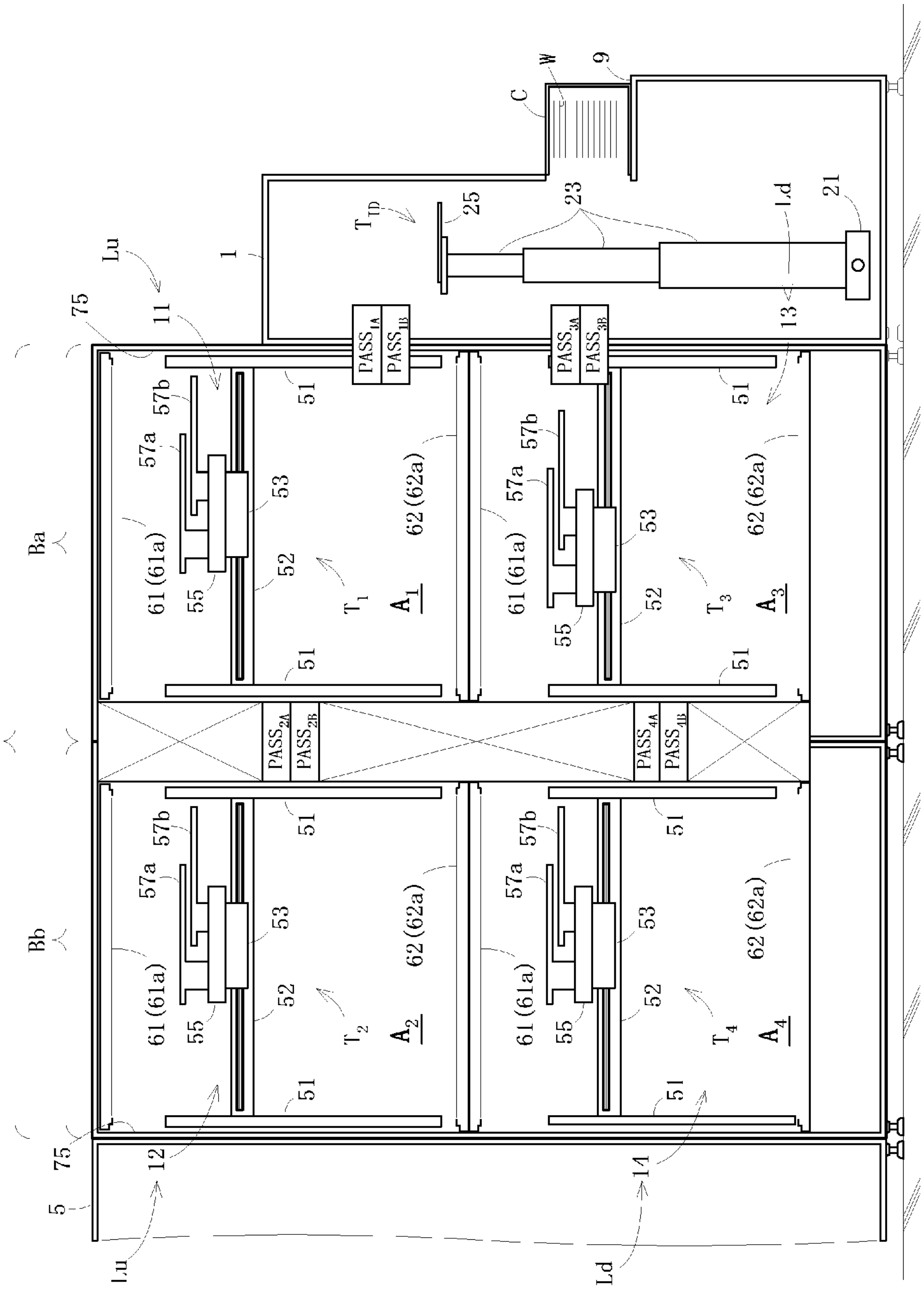

Lu
Ld
1
11
13
3
Ba
Bb
75
75
5
12
14
Lu
Ld
PHP1
AHL1
CP1
PHP3
AHL3
CP3
HP2
CP2
EEW2
PASS5
PHP2
HP4
CP4
EEW4
PASS6
PHP4

Fig.4



Lu
Ld
1
3
5
9
11
12
13
14
21
23
25
75
C
W
T_{ID}
Ba
Bb
51
52
53
55
57a
57b
61 (61a)
62 (62a)
T_1
T_2
T_3
T_4
A_1
A_2
A_3
A_4
$PASS_{1A}$
$PASS_{1B}$
$PASS_{2A}$
$PASS_{2B}$
$PASS_{3A}$
$PASS_{3B}$
$PASS_{4A}$
$PASS_{4B}$

Fig.5

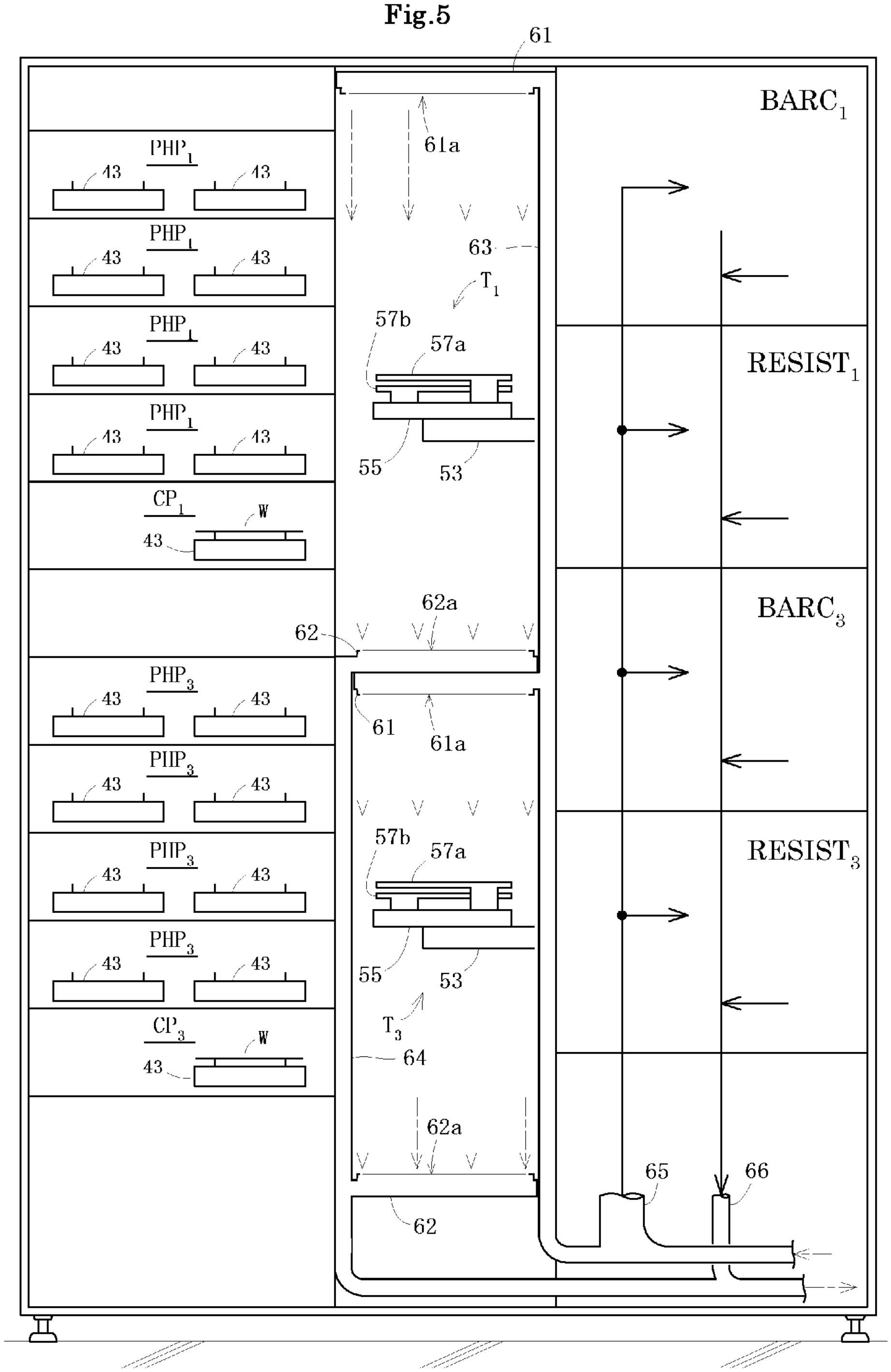
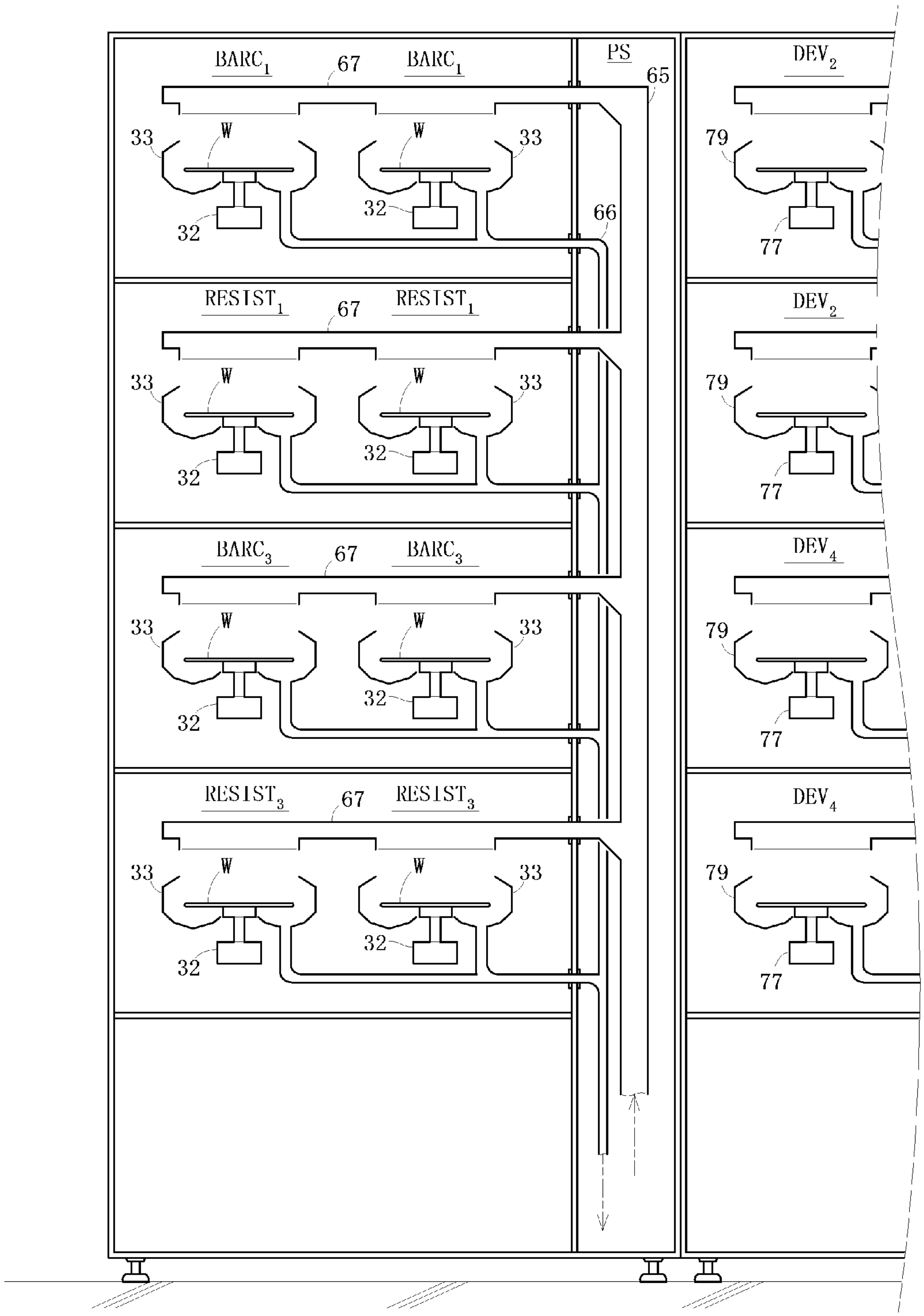
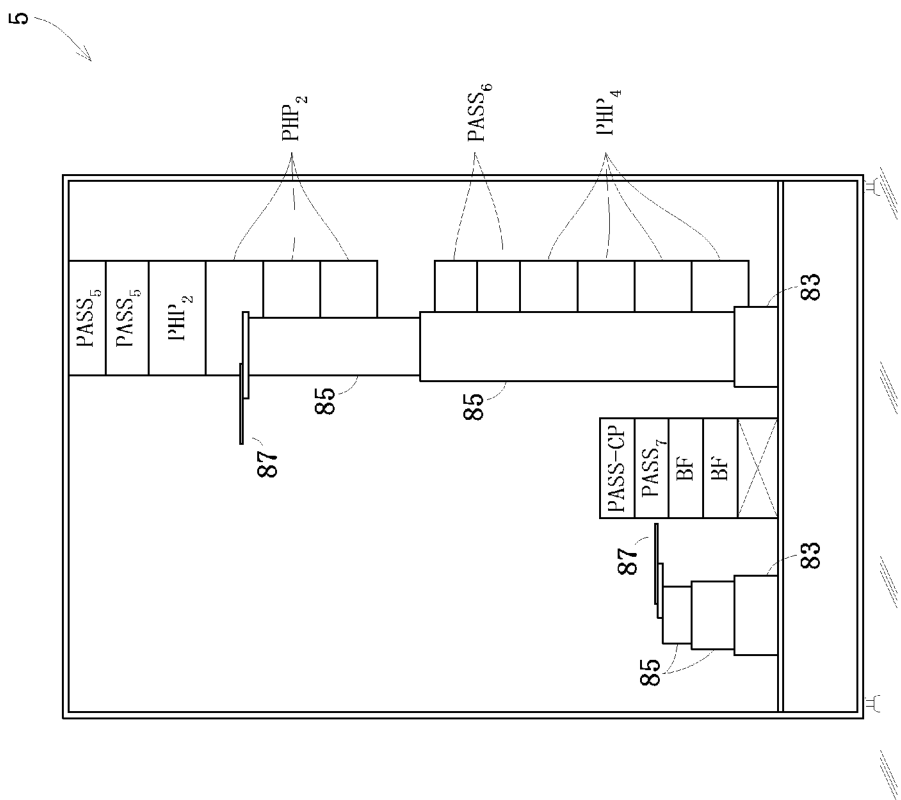

61
BARC1
61a
PHP1
43
43
PHP1
43
43
63
T1
PHP1
43
43
57b
57a
RESIST1
PHP1
43
43
55
53
CP1
W
43
BARC3
62a
62
PHP3
43
43
61
61a
PHP3
43
43
PHP3
43
43
57b
57a
RESIST3
PHP3
43
43
55
53
T3
CP3
W
43
64
62a
65
66
62

Fig.6



BARC1
67
BARC1
PS
65
DEV2
33
W
W
33
79
32
32
66
77
RESIST1
67
RESIST1
DEV2
BARC3
67
BARC3
DEV4
RESIST3
67
RESIST3
DEV4

Fig.7



5
PHP2
PASS6
PHP4
PASS5
PASS5
PHP2
85
85
87
83
PASS-CP
PASS7
BF
BF
87
83
85

Fig.8A

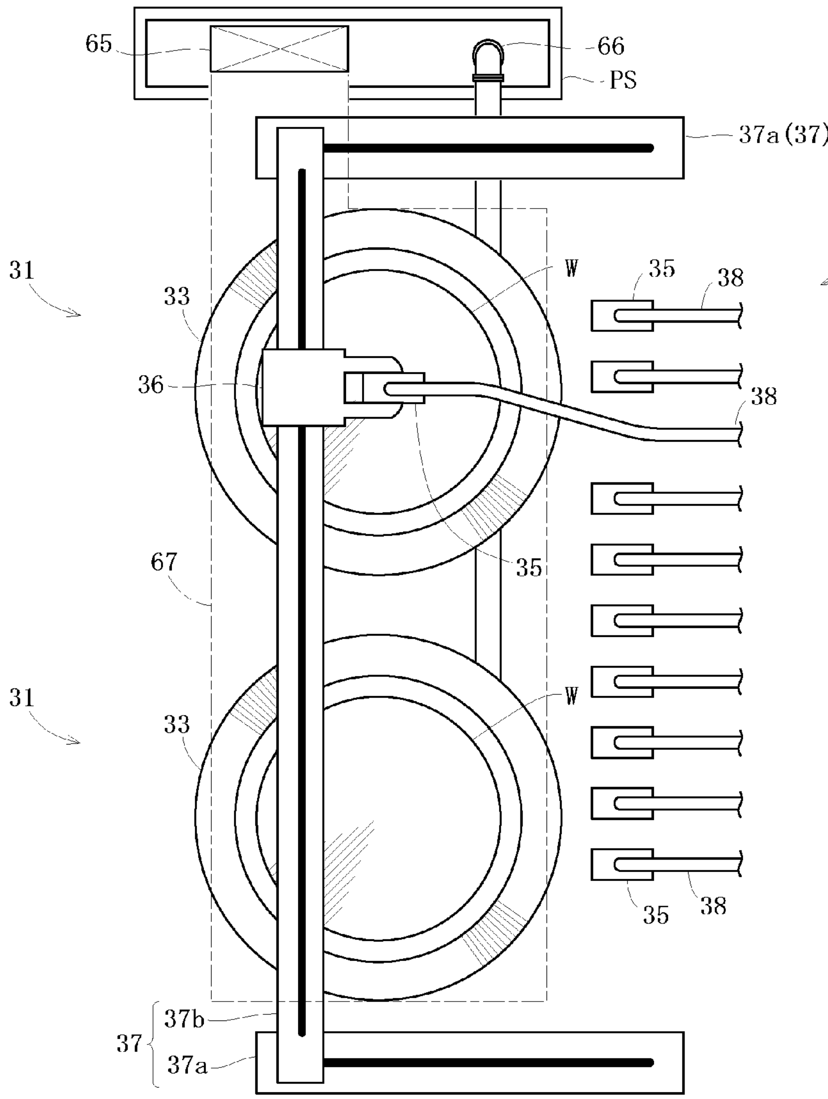

65
66
PS
37a (37)
34
31
33
W
35
38
36
38
35
67
31
33
W
35
38
37b
37
37a

Fig.8B

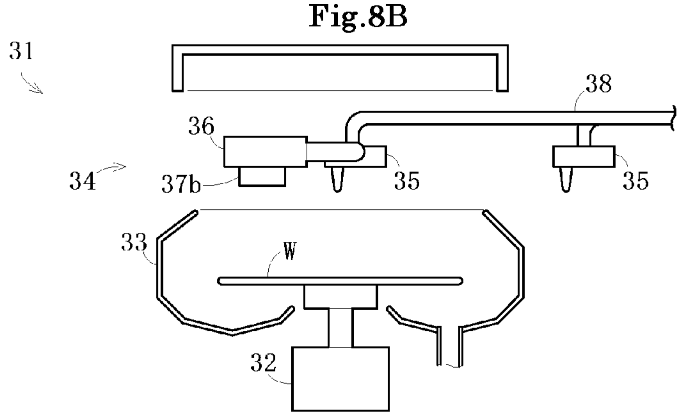

31
38
36
34
37b
35
35
33
W
32

Fig.9

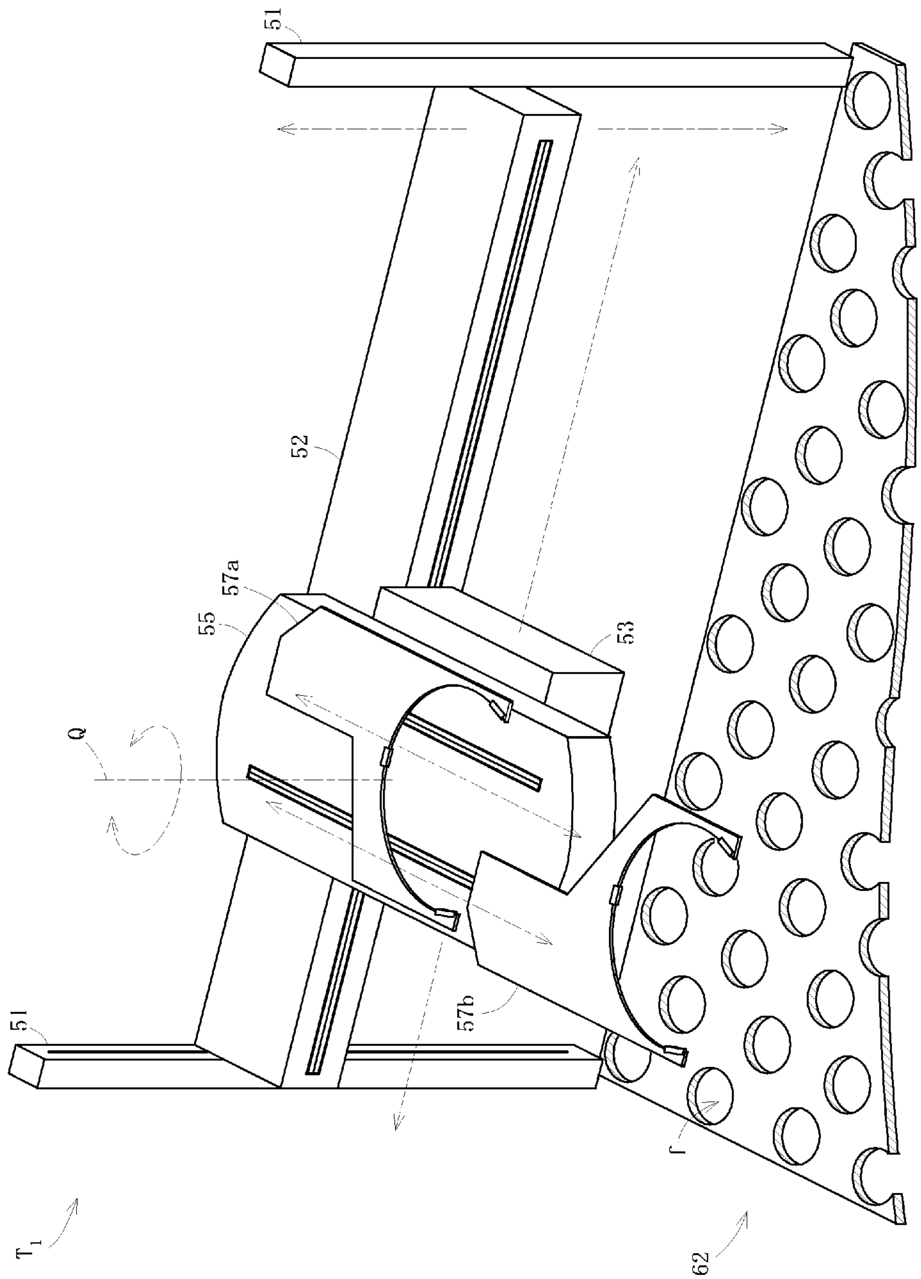


Fig.10

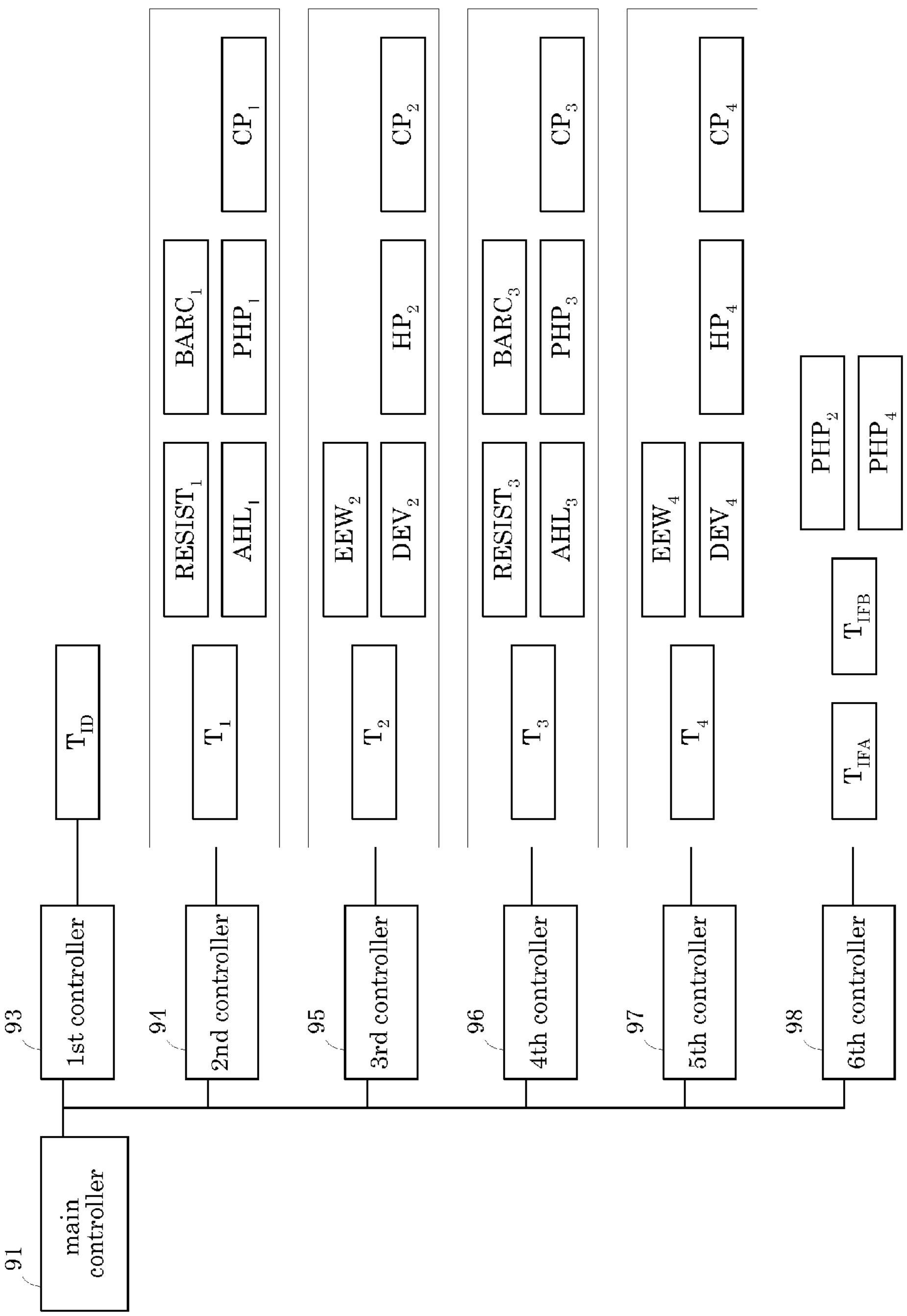

91
main controller
93
1st controller
94
2nd controller
95
3rd controller
96
4th controller
97
5th controller
98
6th controller
T_{ID}
T_1
RESIST$_1$
AHL$_1$
BARC$_1$
PHP$_1$
CP$_1$
T_2
EEW$_2$
DEV$_2$
HP$_2$
CP$_2$
T_3
RESIST$_3$
AHL$_3$
BARC$_3$
PHP$_3$
CP$_3$
T_4
EEW$_4$
DEV$_4$
HP$_4$
CP$_4$
T_{IFA}
T_{IFB}
PHP$_2$
PHP$_4$

Fig.11

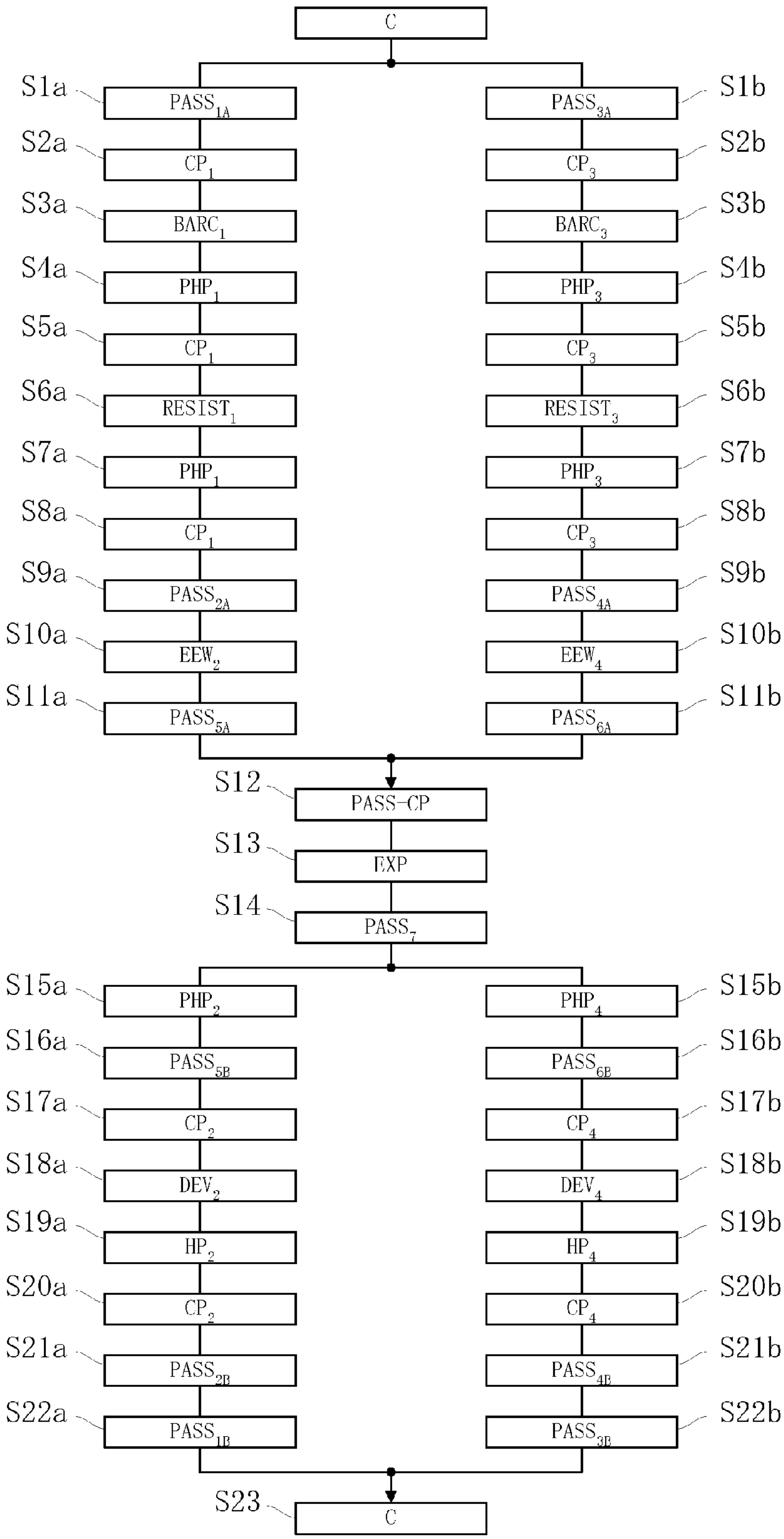

C
S1a
PASS1A
S1b
PASS3A
S2a
CP1
S2b
CP3
S3a
BARC1
S3b
BARC3
S4a
PHP1
S4b
PHP3
S5a
CP1
S5b
CP3
S6a
RESIST1
S6b
RESIST3
S7a
PHP1
S7b
PHP3
S8a
CP1
S8b
CP3
S9a
PASS2A
S9b
PASS4A
S10a
EEW2
S10b
EEW4
S11a
PASS5A
S11b
PASS6A
S12
PASS-CP
S13
EXP
S14
PASS7
S15a
PHP2
S15b
PHP4
S16a
PASS5B
S16b
PASS6B
S17a
CP2
S17b
CP4
S18a
DEV2
S18b
DEV4
S19a
HP2
S19b
HP4
S20a
CP2
S20b
CP4
S21a
PASS2B
S21b
PASS4B
S22a
PASS1B
S22b
PASS3B
S23
C

Fig.12

ID's transport mechanism T_{ID}	main transport mechanism $T_{1/3}$	main transport mechanism $T_{2/4}$	1st transport mechanism T_{IFA}	2nd transport mechanism T_{IFB}
cassette C	receiver $PASS_{1/3}$	receiver $PASS_{2/4}$	receiver $PASS_5$	receiver PASS-CP
receiver $PASS_1$	cooling unit $CP_{1/3}$	edge exposing unit $EEW_{2/4}$	receiver PASS-CP	exposing machine EXP
cassette C	antireflection film coating unit $BARC_{1/3}$	receiver $PASS_{5/6}$	receiver $PASS_7$	receiver $PASS_7$
receiver $PASS_3$	heating and cooling unit $PHP_{1/3}$	cooling unit $CP_{2/4}$	heating and cooling unit PHP_2	
	cooling unit $CP_{1/3}$	developing unit $DEV_{2/4}$	receiver $PASS_5$	
	resist film coating unit $RESIST_{1/3}$	heating unit $HP_{2/4}$	receiver $PASS_6$	
	heating and cooling unit $PHP_{1/3}$		receiver PASS-CP	
	cooling unit $CP_{1/3}$		receiver $PASS_7$	
	receiver $PASS_{2/4}$		heating and cooling unit PHP_4	
			receiver $PASS_6$	

SUBSTRATE TREATING APPARATUS

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 12/163,951, which claims priority to Japanese Patent Application No. 2007-172496, filed Jun. 29, 2007. The disclosures of both of these applications are hereby incorporated by reference in their entirety for all purposes.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

This invention relates to a substrate treating apparatus for performing a series of treatments of substrates such as semiconductor wafers, glass substrates for liquid crystal displays, glass substrates for photomasks, and substrates for optical disks (hereinafter called simply “substrates”).

(2) Description of the Related Art

Conventionally, a substrate treating apparatus is used to form a resist film on substrates, allows the substrates having the resist film formed thereon to be exposed in a separate exposing machine, and develops the exposed substrates. Specifically, the substrate treating apparatus includes a plurality of blocks each having various chemical treating units such as coating units for forming resist film and heat-treating units arranged with a single main transport mechanism. This apparatus transports substrates to each block to be treated therein (as disclosed in Japanese Unexamined Patent Publication No. 2003-324139, for example).

The conventional apparatus with such a construction has the following drawback.

In the conventional apparatus, the main transport mechanism goes through five to 10 transporting steps for treating each substrate in its block, and each transporting step takes several seconds. Supposing that the number of transporting steps is six and each step takes five seconds, the throughput in the block can be raised up to 30 seconds per substrate (or 120 substrates per hour). However, there is not much room for reducing the number of transporting steps for the single main transport mechanism or shortening the time for each transporting step. Hence, it is difficult to achieve a further improvement in throughput of each block. It is therefore difficult to improve the throughput of the entire apparatus. One possible solution is to employ multiple main transport mechanisms. However, an increase in the number of main transport mechanisms in each block entails the inconvenience of increasing the chemical treating units and heating units, thereby enlarging the footprint.

SUMMARY OF THE INVENTION

One of the objectives of this invention is to provide a substrate treating apparatus that can improve throughput without enlarging the footprint of the substrate treating apparatus.

In one embodiment, a substrate treating apparatus comprising a plurality of substrate treatment lines each including a plurality of main transport mechanisms arranged horizontally, and a plurality of treating units provided for each of the main transport mechanisms for treating substrates; each of the substrate treatment lines carrying out a series of treatments of the substrates, with each of the main transport mechanisms transporting the substrates to the treating units associated therewith, and transferring the substrates to the

other main transport mechanism horizontally adjacent thereto; wherein the substrate treatment lines are arranged vertically.

According to this embodiment, the plurality of substrate treatment lines are arranged vertically, so that the substrates are treated in parallel through the respective substrate treatment lines. This realizes an increased throughput of the substrate treating apparatus. Since the substrate treatment lines are arranged vertically, an increase in the installation area of the substrate treating apparatus can be avoided.

The horizontal arrangement of the main transport mechanisms is arbitrary. For example, the main transport mechanisms may be arranged in one row or a plurality of rows extending in one direction. The main transport mechanisms may be arranged at different points on an imaginary curve, or may be arranged in a zigzag pattern. The arrangement of the treating units associated with each main transport mechanism is also arbitrary. The treating units may be arranged horizontally, stacked vertically, or arranged crisscross in a matrix form.

In an alternate embodiment, the main transport mechanisms and the treating units in the respective substrate treatment lines may be in substantially the same arrangement in plan view. One of the benefits realized by this arrangement is that the apparatus construction can be simplified.

The substrate treating apparatus may further comprise gas supply openings for supplying a gas into transporting spaces where the main transport mechanisms are installed, and gas exhaust openings for exhausting the gas from the transporting spaces. This provides the benefit of maintaining the transportation areas substantially free from particulate matter.

In addition, the area of the transporting spaces for each substrate treatment line may be blocked off and separate gas supply openings and gas exhaust openings can be provided for each substrate treatment line. This will result in even cleaner transporting spaces.

The gas supply openings may be formed in a blowout unit and the gas exhaust openings formed in an exhaust unit with at least one of the gas blowout unit and the gas exhaust unit blocking off atmosphere for each of the substrate treatment lines. This realizes a simplified apparatus construction.

The gas supply openings may be arranged in a position higher than the gas exhaust openings further reducing possibility of particulate contamination.

The gas supply openings may be arranged over the transporting spaces, and the gas exhaust openings under the transporting spaces. This arrangement results in downward gas currents and helps to keep the transporting spaces cleaner.

In still another embodiment, the apparatus may further comprise an indexer’s transport mechanism for transporting the substrates to and from a cassette for storing a plurality of substrates, wherein the indexer’s transport mechanism transfers the substrates to and from an end transport mechanism which is one of the main transport mechanisms located in one end region of each of the substrate treatment lines, the indexer’s transport mechanism transferring the substrates to and from an upper one of the end transport mechanisms at a height adjacent a lower portion of the upper one of the end transport mechanisms, and transferring the substrates to and from a lower one of the end transport mechanisms at a height adjacent an upper portion of the lower one of the end transport mechanisms. Since the upper and lower substrate transfer positions are close to each other, the indexer’s transport mechanism moves a reduced amount vertically. This improves the operating efficiency of the indexer’s transport mechanism.

The apparatus may further comprise a receiver provided between the indexer's transport mechanism and each end transport mechanism for receiving the substrates, the indexer's transport mechanism transferring the substrates through the receiver. The transfer of substrates through the receiver can improve the transporting efficiency over the case of transferring the substrates directly between the transport mechanisms.

In yet another embodiment, a substrate treating apparatus comprises a plurality of treating blocks arranged horizontally, each including treating units arranged on each of upper and lower stories, and a main transport mechanism provided for each of the stories for transporting substrates to the treating units on each of the stories; wherein a series of treatments is performed for the substrates by transferring the substrates between the main transport mechanisms of the treating blocks adjacent each other on the same story.

According to this embodiment, substrates are transported to and from the plurality of treating blocks arranged horizontally, and in parallel through the different stories. A series of treatments are performed on the substrates in parallel on the respective stories, each having the plurality of treating blocks. This realizes an increased throughput of the substrate treating apparatus. Since the treating blocks have a layered structure with a plurality of stories arranged vertically, an increase in the installation area of the substrate treating apparatus can be avoided.

In the embodiment noted above, each of the treating blocks may have a housing for collectively accommodating the treating units and the main transport mechanisms included in each of the treating blocks. Then, each treating block can be handled as a unit, thereby simplifying the manufacture and repair of the substrate treating apparatus.

Each of the treating blocks may further include a shielding plate disposed between the respective stories, gas supply openings for supplying a clean gas into a transporting space of the main transport mechanism on each story, and gas exhaust openings for exhausting the gas from the transporting space of the main transport mechanism on each story. This construction can prevent any particles generated by each main transport mechanism from reaching the other story. The transporting space on each story can also be kept clean.

In the above construction, the gas supply openings may be formed in a blowout unit, and the gas exhaust openings in an exhaust unit, at least one of the gas blowout unit and the gas exhaust unit acting as the shielding plate. This simplifies the apparatus construction.

The gas supply openings of each transporting space may be arranged in a position higher than the gas exhaust openings of the transporting space. Then, the air currents in each transporting space form a down-flow, which can keep the transporting space even cleaner.

The apparatus may further comprise an indexer's transport mechanism for transporting the substrates to and from a cassette for storing a plurality of substrates, and for transporting the substrates to the main transport mechanisms on the respective stories of an end one of the treating blocks, wherein the indexer's transport mechanism transfers the substrates, in positions adjacent each other, to and from the main transport mechanisms on the respective stories of the end one of the treating blocks. This enables the indexer's transport mechanism to perform reduced amount of vertical movement, thereby improving the operating efficiency of the indexer's transport mechanism.

The above construction may further comprise substrate receivers provided between the main transport mechanisms on the respective stories of the end one of the treating blocks and the indexer's transport mechanism, the indexer's transport mechanism transferring the substrates through each of the receivers. This construction realizes an improved transporting efficiency compared to transferring the substrates directly between the transport mechanisms.

In a still another embodiment, a substrate treating apparatus comprises an indexer section including an indexer's transport mechanism for transporting substrates to and from a cassette for storing a plurality of substrates; a coating block disposed adjacent the indexer section, and including coating units and heat-treating units arranged on each of upper and lower stories for forming resist film on the substrates, and a main transport mechanism disposed on each story for transporting the substrates to and from the coating units and the heat-treating units on the each story; a developing block disposed adjacent the coating block, and including developing units and heat-treating units arranged on each of upper and lower stories for developing the substrates, and a main transport mechanism disposed on each story for transporting the substrates to and from the developing units and the heat-treating units on the each story; and an interface section disposed adjacent the developing block, and including an interface's transport mechanism for transporting the substrates to and from an exposing machine provided separately from the apparatus; wherein the indexer's transport mechanism transfers the substrates to and from the main transport mechanism on each story of the coating block; the main transport mechanism on each story of the coating block transfers the substrates to and from the main transport mechanism on the same story of the developing block; and the interface's transport mechanism transfers the substrates to and from the main transport mechanism on each story of the developing block.

According to this embodiment, the indexer's transport mechanism takes the substrates out of the cassette in order, and transfers these substrates to the main transport mechanisms on the respective stories of the coating block. Each main transport mechanism of the coating block transports the substrates to the associated coating units and heat-treating units. Each treatment unit carries out a predetermined treatment of the substrates. The main transport mechanism on each story of the coating block transfers the substrates having resist film formed thereon to the main transport mechanism on the same story of the adjoining developing block. Each main transport mechanism of the developing block transfers the substrates to the interface's transport mechanism of the adjoining interface section. The interface's transport mechanism transfers the received substrates to the exposing machine, which is an external apparatus. The exposed substrates are returned to the interface section again. The interface section's transport mechanism transfers the substrates to the main transport mechanism on each story of the developing block. Each main transport mechanism of the developing block transports the substrates to the associated developing units and heat-treating units. Each treating unit carries out a predetermined treatment of the substrates. The main transport mechanism on each story of the developing block transfers the developed substrates the main transport mechanism on the same story of the adjoining coating block. The main transport mechanism on each story of the coating block transfers the substrates to the indexer's transport mechanism of the indexer section. The indexer's transport mechanism stores the substrates in a predetermined cassette. According to this construction, as described above, the coating block and developing block carry out the resist film forming treatment and developing treatment in parallel on each story. This construction, therefore, increases the treating efficiency of the substrate treating apparatus. Since the coating block and developing block have a layered structure with a plurality of stories arranged vertically, an increase in the footprint can be avoided.

The apparatus may further comprise a controller for controlling the interface's transport mechanism to transport the substrates to the exposing machine in an order in which the indexer's transport mechanism has taken the substrates out of the cassette. This helps with tracking multiple substrates within the apparatus.

The interface section may further include a plurality of buffers to temporarily store the substrates. The controller being arranged to control the interface's transport mechanism, when the substrates are delivered from the developing block in an order different from the order in which the indexer's transport mechanism has taken the substrates out of the cassette, to receive the substrates and transport the substrates to the buffers. The substrates are transferred to the buffers in the event that the substrates are delivered from the developing block in an order different from the order in which the indexer's transport mechanism initially took the substrates out of the cassette. This allows the developing block to deliver succeeding substrates. Further, the order of transporting the substrates from the interface section to the exposing machine may be adjusted to the order in which the indexer's transport mechanism has taken the substrates out of the cassette. Thus, the substrates can be treated conveniently in a predetermined order.

The coating units for forming resist film on the substrates may include a resist film coating unit for applying a resist film material to the substrates, and an anti-reflection film coating unit for applying an anti-reflection film forming solution to the substrates.

This specification discloses several embodiments directed to the following substrate treating apparatus:

(1) A substrate treating apparatus is provided wherein the series of treatments carried out in each of the substrate treatment lines is the same.

According to the embodiment defined in (1) above, the apparatus construction can be simplified.

(2) A substrate treating apparatus is provided wherein said treating units include solution treating units for treating the substrates with a solution, and heat-treating units for heat-treating the substrates.

(3) A substrate treating apparatus is provided in another embodiment wherein said treating units include solution treating units for treating the substrates with a solution, and heat-treating units for heat-treating the substrates.

According to the embodiment defined in (2) and (3) above, various treatments can be carried out for the substrates.

(4) A substrate treating apparatus is provided further comprising a single, second gas supply pipe for supplying a clean gas to each of the treating units associated with the respective main transport mechanisms arranged vertically.

According to the embodiment defined in (4) above, the installation area can be reduced.

(5) A substrate treating apparatus is provided in which the main transport mechanisms on the respective stories of each treating block are arranged in the same position in plan view.

According to the embodiment defined in (5) above, the apparatus construction can be simplified.

(6) A substrate treating apparatus is provided in which the treating units arranged vertically of each treating block perform the same treatment.

According to the embodiment defined in (6) above, the apparatus construction can be simplified.

(7) A substrate treating apparatus is provided further comprising a single, second gas supply pipe for supplying a clean gas to the treating units arranged vertically.

According to the embodiment defined in (7) above, the installation area can be reduced.

(8) A substrate treating apparatus is provided wherein the treating units on each story are stacked.

According to the embodiment defined in (8) above, the apparatus construction can be simplified.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of illustrating the invention, there are shown in the drawings several forms which are presently preferred, it being understood, however, that the invention is not limited to the precise arrangement and instrumentalities shown.

FIG. **1** is a plan view showing an outline of a substrate treating apparatus according to an embodiment of the present invention;

FIG. **2** is a schematic side view showing an arrangement of treating units included in the substrate treating apparatus;

FIG. **3** is a schematic side view showing an arrangement of treating units included in the substrate treating apparatus;

FIG. **4** is a view in vertical section taken on line a-a of FIG. **1**;

FIG. **5** is a view in vertical section taken on line b-b of FIG. **1**;

FIG. **6** is a view in vertical section taken on line c-c of FIG. **1**;

FIG. **7** is a view in vertical section taken on line d-d of FIG. **1**;

FIG. **8**A is a plan view of coating units;

FIG. **8**B is a sectional view of a coating unit,

FIG. **9** is a perspective view of a main transport mechanism;

FIG. **10** is a control block diagram of the substrate treating apparatus according to an embodiment of the present invention;

FIG. **11** is a flow chart of a series of treatments of wafers W; and

FIG. **12** is a view schematically showing operations repeated by each transport mechanism.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Embodiments of this invention will be described in detail hereinafter with reference to the drawings.

FIG. **1** is a plan view showing an outline of a substrate treating apparatus according to an embodiment of the present invention. FIGS. **2** and **3** are schematic side views showing an arrangement of treating units included in the substrate treating apparatus. FIGS. **4** through **7** are views in vertical section taken on lines a-a, b-b, c-c and d-d of FIG. **1**, respectively.

This embodiment provides a substrate treating apparatus for forming resist film on substrates (e.g. semiconductor wafers) W, and developing exposed wafers or substrates W. This apparatus is divided into an indexer section (hereinafter called "ID section") **1**, a treating section **3**, and an interface section (hereinafter called "IF section") **5**. The ID section **1** and IF section **5** are arranged adjacent to and on the opposite sides of the treating section **3**. An exposing machine EXP which is an external apparatus separate from this apparatus is disposed adjacent to the IF section **5**.

The ID section **1** takes wafers W out of each cassette C, which stores a plurality of wafers W, and deposits wafers W in the cassette C. The ID section **1** has a cassette table **9** for receiving cassettes C and an ID's transport mechanism T_{ID} for transporting wafers W to and from each cassette C. The ID's transport mechanism T_{ID} corresponds to the indexer's transport mechanism in this embodiment.

The treating section **3** includes four main transport mechanisms T_1, T_2, T_3 and T_4. The treating section **3** is divided into a first to a fourth cells **11**, **12**, **13** and **14** associated with the respective main transport mechanisms T_1, T_2, T_3 and T_4. The first and third cells **11** and **13** are used for forming resist film on the wafers W. The second and fourth cells **12** and **14** are used for developing the wafers W. Each of the cells **11-14** has a plurality of treating units (to be described hereinafter). The main transport mechanisms T_1, T_2, T_3 and T_4 transport the wafers W to and from the treating units of the respective cells **11-14**.

The first and second cells **11** and **12** juxtaposed horizontally are connected to each other to form a substrate treatment line Lu extending between the ID section **1** and IF section **5**. The third and fourth cells **13** and **14** juxtaposed horizontally are also connected to each other to form a substrate treatment line Ld extending between the ID section **1** and IF section **5**. These two substrate treatment lines Lu and Ld are arranged one over the other. In other words, the treating section **3** has a layered structure with the plurality of substrate treatment lines Lu and Ld arranged vertically.

The substrate treatment lines Lu and Ld are arranged one over the other to adjoin each other. That is, the first cell **11** is located over the third cell **13**, and the second cell **12** over the fourth cell **14**. Therefore, the treating section **3** may be constructed easily by horizontally arranging a treating block Ba having the first and third cells **11** and **13** formed integrally, and a treating block Bb having the second and fourth cells **12** and **14** formed integrally.

The IF section **5** transfers wafers W to and from the exposing machine EXP. The IF section **5** has IF's transport mechanisms T_{IF} for transporting wafers W. The IF's transport mechanisms T_{IF} include a first transport mechanism T_{IFA} and a second transport mechanism T_{IFB}. The first transport mechanism T_{IFA} and second transport mechanism T_{IFB} correspond to the interface's transport mechanisms in this embodiment.

The ID's transport mechanism T_{ID} transfers wafers W to and from the main transport mechanisms T_1 and T_3 of the first and third cells **11** and **13** located adjacent the ID section **1**. The main transport mechanisms T_1-T_4 of the cells **11-14** transfer wafers W to and from the other cells connected thereto on the same stories. The IF's transport mechanisms T_{IF} transfer wafers W to and from the main transport mechanisms T_2 and T_4 of the second and fourth cells **12** and **14** located adjacent the IF section **5**. As a result, wafers W are transported between the ID section **1** and IF section **5** in parallel through the two substrate treatment lines Lu and Ld, to undergo a series of treatments in each of the substrate treatment lines Lu and Ld. The main transport mechanisms T_1 and T_3 correspond to the end transport mechanisms in this embodiment.

This apparatus includes receivers $PASS_1$ and $PASS_3$ for transferring wafers W between the ID's transport mechanism T_{ID} and main transport mechanisms T_1 and T_3. Similarly, a receiver $PASS_2$ is provided for transferring wafers W between the main transport mechanisms T_1 and T_2, and a receiver $PASS_4$ for transferring wafers W between the main transport mechanisms T_3 and T_4. Further, receivers $PASS_5$ and $PASS_6$ are provided for transferring wafers W between the main transport mechanisms T_2 and T_4 and IF's transport mechanisms T_{IF}. Each of the receivers $PASS_1$-$PASS_6$ has a plurality of support pins projecting therefrom, for receiving a wafer W in a substantially horizontal position on these support pins.

[ID Section **1**]

The ID section **1** will be described next. The cassette table **9** can receive four cassettes C arranged in a row. The ID's transport mechanism T_{ID} has a movable base **21** for moving horizontally alongside the cassette table **9** in the direction of arrangement of the cassettes C, a lift shaft **23** vertically extendible and contractible relative to the movable base **21**, and a holding arm **25** swivelable on the lift shaft **23**, and extendible and retractable radially of the swivel motion, for holding a wafer W. The ID's transport mechanism TID can transport wafers W between each cassette C and the receivers $PASS_1$ and $PASS_3$.

[First Cell **11**]

A belt-like transporting space A**1** for transporting wafers W extends through the center of the first cell **11** and parallel to the direction of arrangement of the first and second cells **11** and **12**. The treating units of the first cell **11** are coating units **31** for applying a treating solution to the wafers W, and heat-treating units **41** for heat-treating the wafers W. The coating units **31** are arranged on one side of the transporting space A_1, while the heat-treating units **41** are arranged on the other side thereof.

The coating units **31** are arranged vertically and horizontally, each facing the transporting space A**1**. In this embodiment, four coating units **31** in total are arranged in two columns and two rows. The coating units **31** include anti-reflection film coating units BARC for forming anti-reflection film on the wafers W, and resist film coating units RESIST for forming resist film on the wafers W. The coating units **31** correspond to the solution treating units in this embodiment.

Reference is made to FIGS. **8**A and **8**B. FIG. **8**A is a plan view of the coating units **31**. FIG. **8**B is a sectional view of a coating unit **31**. Each coating unit **31** includes a spin holder **32** for holding and spinning a wafer W, a cup **33** surrounding the wafer W, and a supply device **34** for supplying a treating solution to the wafer W. The two sets of spin holders **32** and cups **33** at each level are juxtaposed with no partition wall or the like in between. The supply device **34** includes a plurality of nozzles **35**, a gripper **36** for gripping one of the nozzles **35**, and a nozzle moving mechanism **37** for moving the gripper **36** to move one of the nozzles **35** between a treating position above the wafer W and a standby position away from above the wafer W. Each nozzle **35** has one end of a treating solution pipe **38** connected thereto. The treating solution pipe **38** is arranged movable to permit movement of the nozzle **35** between the standby position and treating position. The other end of each treating solution pipe **38** is connected to a treating solution source (not shown). Specifically, in the case of anti-reflection film coating units BARC, the treating solution sources supply different types of treating solution for antireflection film to the respective nozzles **35**. In the case of resist film coating units RESIST, the treating solution sources supply different types of resist film material to the respective nozzles **35**.

The nozzle moving mechanism **37** has first guide rails **37***a* and a second guide rail **37***b*. The first guide rails **37***a* are arranged parallel to each other and outwardly of the two cups **33** arranged sideways. The second guide rail **37***b* is slidably supported by the two first guide rails **37***a* and disposed above the two cups **33**. The gripper **36** is slidably supported by the second guide rail **37***b*. The first guide rails **37***a* and second guide rail **37***b* take guiding action substantially horizontally and in directions substantially perpendicular to each other. The nozzle moving mechanism **37** further includes drive members (not shown) for sliding the second guide rail **37***b*, and sliding the gripper **36**. The drive members are operable to move the nozzle **35** gripped by the gripper **36** to the treating positions above the two spin holders **32**.

Referring back to FIG. **1** and FIG. **3**, the plurality of heat-treating units **41** are arranged vertically and horizontally, each facing the transporting space A**1**. In this embodiment, three heat-treating units **41** can be arranged horizontally, and five heat-treating units **41** can be stacked vertically. Each heat-treating unit **41** has a plate **43** for receiving a wafer W. The heat-treating units **41** include cooling units CP for cooling wafers W, heating and cooling units PHP for carrying out heating and cooling treatments continually, and adhesion units AHL for heat-treating wafers W in an atmosphere of hexamethyl silazane (HMDS) vapor in order to promote adhesion of coating film to the wafers W. As shown in FIG. **5**, each heating and cooling unit PHP has two plates **43**, and a local transport mechanism (not shown) for moving a wafer W between the two plates **43**. The various types of heat-treating units CP, PHP and AHL are arranged in appropriate positions.

Reference is made to FIG. **9**. FIG. **9** is a perspective view of the main transport mechanism T_1. The main transport mechanism T_1 has two guide rails **51** for providing vertical guidance, and a guide rail **52** for providing horizontal guidance. The vertical guide rails **51** are fixed opposite each other at one side of the transporting space A_1. In this embodiment, the vertical guide rails **51** are arranged at the side adjacent the coating units **31**. The horizontal guide rail **52** is slidably attached to the vertical guide rails **51**. The horizontal guide rail **52** has a base **53** slidably attached thereto. The base **53** extends transversely, substantially to the center of the transporting space A_1. Further, drive members (not shown) are provided for vertically moving the horizontal guide rail **52**, and horizontally moving the base **53**. The drive members are operable to move the base **53** to positions for accessing the coating units **31** and heat-treating units **41** arranged vertically and horizontally.

The base **53** has a turntable **55** rotatable about a vertical axis Q. The turntable **55** has two holding arms **57***a* and **57***b* horizontally movably attached thereto for holding wafers W, respectively. The two holding arms **57***a* and **57***b* are arranged vertically close to each other. Further, drive members (not shown) are provided for rotating the turntable **55**, and moving the holding arms **57***a* and **57***b*. The drive members are operable to move the turntable **55** to positions opposed to the coating units **31**, heat-treating units **41** and receivers $PASS_1$ and $PASS_2$, and to extend and retract the holding arms **57***a* and **57***b* to and from the coating units **31** and so on.

[Third Cell **13**]

The third cell **13** will be described next. Like reference numerals are used to identify like parts which are the same as in the first cell **11**, and will not be described again. The layout in plan view of the main transport mechanism T_3 and treating units in the third cell **13** is substantially the same as in the first cell **11**. It can be said, therefore, that the coating units **31** are vertically stacked over the different stories of the first cell **11** and third cell **13**. Similarly, it can be said that the heat-treating units **41** also are vertically stacked over the different stories. The arrangement of the various treating units of the third cell **13** as seen from the main transport mechanism T_3 is substantially the same as the arrangement of the various treating units of the first cell **11** as seen from the main transport mechanism T_1.

In the following description, when distinguishing the resist film coating units RESIST in the first and third cells **11** and **13**, subscripts "1" and "3" will be affixed (for example, the resist film coating units RESIST in the first cell **11** will be referred to as "resist film coating units $RESIST_1$").

[First Cell **11** and Third Cell **13**]

Reference is made to FIG. **4**. Constructions relevant to the first cell **11** and third cell **13** will be described collectively. The receiver $PASS_1$ is disposed between the ID section **1** and first cell **11**. The receiver $PASS_3$ is disposed between the ID section **1** and third cell **13**. The receivers $PASS_1$ and $PASS_3$ are arranged in plan view at the ends of the transporting spaces A_1 and A_3 adjacent the ID section **1**, respectively. Seen in a sectional view, the receiver $PASS_1$ is disposed at a height adjacent a lower part of the main transport mechanism T_1, while the receiver $PASS_3$ is disposed at a height adjacent an upper part of the main transport mechanism T_3. Therefore, the positions of receiver $PASS_1$ and receiver $PASS_3$ are close to each other for allowing the ID's transport mechanism T_{ID} to access the receiver $PASS_1$ and receiver $PASS_3$ using only a small amount of vertical movement.

Each of the receiver $PASS_1$ and receiver $PASS_3$ includes a plurality of (two) receivers arranged one over the other. Of the two receivers $PASS_1$, one $PASS_{1A}$ serves to pass wafers W from the ID's transport mechanism T_{ID} to the main transport mechanism T_1, and the wafers W are deposited on the receiver $PASS_{1A}$ solely by the ID's transport mechanism T_{ID}. The other receiver $PASS_{1B}$ serves to pass wafers W from the main transport mechanism T_1 to the ID's transport mechanism T_{ID}, and the wafers W are deposited on the receiver $PASS_{1B}$ solely by the main transport mechanism T_1. Each of the receivers $PASS_2$, $PASS_4$, $PASS_5$ and $PASS_6$ described hereinafter similarly includes two receivers used for transferring wafers W in opposite directions.

The receiver $PASS_2$ is disposed between the first cell **11** and second cell **12**. The receiver $PASS_4$ is disposed between the third cell **13** and fourth cell **14**. The receivers $PASS_2$ and $PASS_4$ are arranged in the same position in plan view. Buffers for temporarily storing wafers W and heat-treating units for heat-treating wafers W (neither being shown) are arranged in appropriate positions above and below the receivers $PASS_2$ and $PASS_4$.

Each of the transporting spaces A_1 and A_3 has a first blowout unit **61** for blowing out a clean gas, and an exhaust unit **62** for sucking the gas. Each of the first blowout unit **61** and exhaust unit **62** is in the form of a flat box having substantially the same area as the transporting space A_1 in plan view. Each of the first blowout unit **61** and exhaust unit **62** has first blowout openings **61***a* or exhaust openings **62***a* formed in one surface thereof. In this embodiment, the first blowout openings **61***a* or exhaust openings **62***a* are in the form of numerous small bores f. The first blowout units **61** are arranged over the transporting spaces A_1 and A_3 with the first blowout openings **61***a* directed downward. The exhaust units **62** are arranged under the transporting spaces A_1 and A_3 with the exhaust openings **62***a* directed upward. The atmosphere in the transporting space A_1 and the atmosphere in the transporting space A_3 are blocked off by the exhaust unit **62** of the transporting space A_1 and the first blowout unit **61** of the transporting space A_3. The first blowout openings **61***a* correspond to the gas supply ports in this embodiment. The exhaust openings **62***a* correspond to the gas exhaust ports in this embodiment. The first blowout units **61** correspond to the blowout units in this embodiment.

Referring to FIG. **5**, the first blowout units **61** of the transporting spaces A_1 and A_3 are connected to a common, first gas supply pipe **63**. The first gas supply pipe **63** extends laterally of the receivers $PASS_2$ and $PASS_4$ from an upper position of the transporting space A_1 to a lower position of the transporting space A_3, and is bent below the transporting space A_3 to extend horizontally. The other end of the first gas supply pipe **63** is connected to a gas source not shown. Similarly, the exhaust units **62** of the transporting spaces A_1 and A_3 are connected to a common, first gas exhaust pipe **64**. The first gas exhaust pipe **64** extends laterally of the receivers $PASS_2$ and $PASS_4$ from a lower position of the transporting space A_1 to a lower position of the transporting space A_3, and is bent below the transporting space A_3 to extend horizontally. As the gas is blown out of each first blowout opening **61***a* and sucked and exhausted through each exhaust opening **62***a* of the transporting spaces A_1 and A_3, gas currents are formed to flow from top to bottom of the transporting spaces A_1 and A_3, thereby keeping each of the transporting spaces A_1 and A_3 in a clean state.

Each coating unit **31** of the first and third cells **11** and **13** has a pit portion PS extending vertically. The pit portion PS accommodates a second gas supply pipe **65** extending vertically for supplying the clean gas, and a second gas exhaust pipe **66** extending vertically for exhausting the gas. Each of the second gas supply pipe **65** and second gas exhaust pipe **66** branches at a predetermined height in each coating unit **31** to extend substantially horizontally from the pit portion PS. A plurality of branches of the second gas supply pipe **65** are connected to second blowout units **67** for blowing out the gas downward. A plurality of branches of the second gas exhaust pipe **66** are connected for communication to the bottoms of the respective cups **33**. The other end of the second gas supply pipe **65** is connected to the first gas supply pipe **63** below the third cell **13**. The other end of the second gas exhaust pipe **66** is connected to the first gas exhaust pipe **64** below the third cell **13**. As the gas is blown out of the second blowout units **67** and exhausted through the second exhaust pipes **62***a*, the atmosphere inside each cup **33** is constantly maintained clean, thereby allowing for excellent treatment of the wafer W held by the spin holder **32**.

The pit portions PS further accommodate piping of the treating solutions, electric wiring and the like (not shown). Thus, with the pit portions PS accommodating the piping and electric wiring provided for the coating units **31** of the first and third cells **11** and **13**, the piping and electric wiring can be reduced in length.

The main transport mechanisms T_1 and T_3 and treating units of the first cell **11** and third cell **13** are mounted in one housing **75**. (See FIG. **4**). This housing **75** defines one treating block Ba. The treating block Ba integrating the first cell **11** and third cell **13** corresponds to the coating block in this embodiment. Similarly, the main transport mechanisms T_2 and T_4 and treating units of the second cell **12** and fourth cell **14** described hereinafter are mounted in a different housing **75**. This housing **75** defines another treating block Bb. The treating block Bb integrating the second cell **12** and fourth cell **14** corresponds to the developing block in this embodiment. Thus, with the housings **75** defining the treating blocks Ba and Bb integrating the cells arranged vertically, the treating section **3** may be manufactured and assembled simply.

[Second Cell **12**]

The second cell **12** will be described next. Like reference numerals are used to identify like parts which are the same as in the first cell **11** and will not be described again. The second cell **12** has a transporting space A_2 formed as an extension of the transporting space A_1.

The treating units of the second cell **12** are developing units DEV for developing wafers W, heat-treating units **42** for heat-treating the wafers W, and an edge exposing unit EEW for exposing peripheral regions of the wafers W. The developing units DEV are arranged at one side of the transporting space A_2, and the heat-treating units **42** and edge exposing unit EEW are arranged at the other side of the transporting space A_2. Preferably, the developing units DEV are arranged at the same side as the coating units **31**. It is also preferable that the heat-treating units **42** and edge exposing unit EEW are arranged in the same row as the heat-treating units **41**.

In one embodiment, the number of developing units DEV is four, and sets of two units DEV arranged horizontally along the transporting space A_2 are stacked one over the other. Each developing unit DEV includes a spin holder **77** for holding and spinning a wafer W, and a cup **79** surrounding the wafer W. The two developing units DEV arranged at the lower level are not separated from each other by a partition wall or the like. A supply device **81** is provided for supplying developers to the two developing units DEV. The supply device **81** includes two slit nozzles **81***a* having a slit or a row of small bores for delivering the developers. The slit or row of small bores, preferably, has a length corresponding to the diameter of wafer W. Preferably, the two slit nozzles **81***a* are arranged to deliver developers of different types or concentrations. The supply device **81** further includes a moving mechanism **81***b* for moving each slit nozzle **81***a*. Thus, the slit nozzles **81***a* are movable, respectively, over the two spin holders **77** juxtaposed sideways.

The plurality of heat-treating units **42** are arranged sideways along the transporting space A_2, and stacked one over the other. Each heat-treating unit **42** includes a heating unit HP for heating wafers W and a cooling unit CP for cooling wafers W.

The single edge exposing unit EEW is disposed in a predetermined position. The edge exposing unit EEW includes a spin holder (not shown) for holding and spinning a wafer W, and a light emitter (not shown) for exposing edges of the wafer W held by the spin holder.

The receiver $PASS_5$ and heating and cooling units PHP are stacked in a position facing the transporting space A_2 and adjacent the IF section **5**. The stack of receiver $PASS_5$ and heating and cooling units PHP has one side thereof located adjacent one of the heat-treating units **42**, and is aligned with the heat-treating units **42**. As distinct from the heat-treating units **42** of the second cell **12**, the heating and cooling units PHP rely on the IF's transport mechanism TIF for transport of wafers W. In terms of layout, the heating and cooling units PHP are mounted in the same housing **75** as the second and fourth cells **12** and **14**. These heating and cooling units PHP and receiver $PASS_5$ are constructed for allowing wafers W to be loaded and unloaded through the front thereof opposed to the transporting space A_2 and the side opposed to the IF section **5**.

The main transport mechanism T_2 is disposed substantially centrally of the transporting space A_2 in plan view. The main transport mechanism T_2 has the same construction as the main transport mechanism T_1. The main transport mechanism T_2 transports wafers W to and from the receiver $PASS_2$, various heat-treating units **42**, edge exposing unit EEW and receiver $PASS_5$.

[Fourth Cell **14**]

Like reference numerals are used to identify like parts which are the same as in the first and second cells **11** and **12**, and will not be described again. The layout in plan view of the main transport mechanism T_4 and treating units in the fourth cell **14** is substantially the same as that of the second cell **12**. The arrangement of the various treating units of the fourth cell **14** as seen from the main transport mechanism T_4 is substantially the same as the arrangement of the various treating units of the second cell **12** as seen from the main transport mechanism T_2. Thus, the developing units DEV of the second cell **12** and fourth cell **14** are stacked vertically. Similarly, the heat-treating units **42** of the second cell **12** and fourth cell **14** are stacked vertically.

[Second Cell **12** and Fourth Cell **14**]

Constructions relevant to the second cell **12** and fourth cell **14** also are substantially the same as the constructions relevant to the first cell **11** and third cell **13**, and will be described briefly. Each of the transporting spaces A_2 and A_4 of the second and fourth cells **12** and **14** also has constructions corresponding to the first blowout unit **61** and exhaust unit **62**. Each developing unit DEV of the second and fourth cells **12** and **14** also has constructions corresponding to the second blowout unit **67** and second gas exhaust pipe **66**.

In the following description, when distinguishing the developing units DEV, edge exposing units EEW, and so on in the second and fourth cells **12** and **14**, subscripts "2" and "4" will be affixed (for example, the heating units HP in the second cell **12** will be referred to as "heating units HP**2**").

[IF Section **5**, etc.]

Reference is now made to FIG. **1** and FIG. **7**. The first transport mechanism T_{IFA} and second transport mechanism TIFB are arranged in a direction perpendicular to the arrangement of cells **11** and **12** (**13** and **14**). The first transport mechanism T_{IFA} is disposed at the side where the heat-treating units **42** and so on of the second and fourth cells **12** and **14** are located. The second transport mechanism T_{IFB} is disposed at the side where the developing units DEV of the second fourth cells **12** and **14** are located. Stacked in multiples stages between the first and second transport mechanisms T_{IFA} and T_{IFB} are a receiver PASS-CP for receiving and cooling wafers W, a receiver $PASS_7$ for receiving wafers W, and buffers BF for temporarily storing wafers W.

The first transport mechanism T_{IFA} includes a fixed base **83**, lift shafts **85** vertically extendible and contractible relative to the base **83**, and a holding arm **87** swivelable on the lift shafts **85**, and extendible and retractable radially of the swivel motion, for holding a wafer W. The first transport mechanism TIFA transports wafers W between the heating and cooling units (PHP_2, PHP_4), receivers ($PASS_5$, $PASS_6$, PASS-CP) and buffers BF. The second transport mechanism T_{IFB} also has a base **83**, lift shafts **85** and a holding arm **87** for transporting wafers W between the receivers (PASS-CP, $PASS_7$) and exposing machine EXP.

A control system of this apparatus will be described next. FIG. **10** is a control block diagram of the substrate treating apparatus according to the embodiment. As shown, this apparatus includes a main controller **91** and a first to a sixth controllers **93**, **94**, **95**, **96**, **97** and **98**.

The first controller **93** controls substrate transport by the ID's transport mechanism T_{ID}. The second controller **94** controls substrate transport by the main transport mechanism T_1, and substrate treatment in the resist film coating units $RESIST_1$, antireflection film coating units $BARC_1$, cooling units CP_1, heating and cooling units PHP_1 and adhesion units AHL_1. The third controller **95** controls substrate transport by the main transport mechanism T_2, and substrate treatment in the edge exposing unit EEW_2, developing units DEV_2, heating units HP_2 and cooling units CP_2. The controls by the fourth and fifth controllers **96** and **97** correspond to those by the second and third controllers **94** and **95**, respectively. The sixth controller **98** controls substrate transport by the first and second transport mechanisms T_{IFA} and T_{IFB}, and substrate treatment in the heating and cooling units PHP_2 and PHP_4. The first to sixth controllers **93-98** carry out the controls independently of one another.

The main controller **91** performs overall control of the first to sixth controllers **93-98**. Specifically, the main controller **91** controls coordination among the transport mechanisms. For example, the main controller **91** adjusts the timing of the respective transport mechanisms making access to the receivers $PASS_1$-$PASS_6$. The main controller **91** also controls wafers W to be transported to the exposing machine EXP in the order in which the wafers W are fetched from the cassettes C.

Each of the main controller **91** and the first to sixth controllers **93-98** is realized by a central processing unit (CPU) which performs various processes, a RAM (Random Access Memory) used as the workspace for operation processes, and a storage medium such as a fixed disk for storing a variety of information including a predetermined processing recipe (processing program). The main controller **91** and the first to sixth controllers **93-98** correspond to the controller in this embodiment.

Next, operation of the substrate treating apparatus in this embodiment will be described. FIG. **11** is a flow chart of a series of treatments of wafers W, indicating the treating units and receivers to which the wafers W are transported in order. FIG. **12** is a view schematically showing operations repeated by each transport mechanism, and specifying an order of treating units, receivers and cassettes accessed by the transport mechanisms. The following description will be made separately for each transport mechanism.

[ID's Transport Mechanism T_{ID}]

The ID's transport mechanism T_{ID} moves to a position opposed to one of the cassettes C, holds with the holding arm **25** a wafer W to be treated and takes the wafer W out of the cassette C. The ID's transport mechanism T_{ID} swivels the holding arm **25**, vertically moves the lift shaft **23**, moves to a position opposed to the receiver $PASS_1$, and places the wafer W on the receiver $PASS_{1A}$ (which corresponds to step S**1***a* in FIG. **11**; only step numbers will be indicated hereinafter). At this time, a wafer W usually is present on the receiver $PASS_{1B}$, and the ID's transport mechanism T_{ID} receives this wafer W and stores it in a cassette C (step S**23**). When there is no wafer W on the receiver $PASS_{1B}$, the ID's transport mechanism T_{ID} just accesses the cassette C. Then, the ID's transport mechanism T_{ID} transports a wafer W from the cassette C to the receiver $PASS_{3A}$ (step S**1***b*). Here again, if a wafer W is present on the receiver $PASS_{3B}$, the ID's transport mechanism T_{ID} will store this wafer W in a cassette C (step S**23**).

The ID's transport mechanism T_{ID} repeats the above operation. This operation is controlled by the first controller **93**. As a result, the wafers W taken out one at a time from the cassette C are transported alternately to the first cell **11** and third cell **13**.

[Main Transport Mechanisms T_1, T_3]

Since operation of the main transport mechanism T_3 is substantially the same as operation of the main transport mechanism T_1, only the main transport mechanism T_1 will be described. The main transport mechanism T_1 moves to a position opposed to the receiver $PASS_1$. At this time, the main transport mechanism T_1 holds, on one holding arm **57** (e.g. **57***b*), a wafer W received immediately before from the receiver $PASS_{2B}$. The main transport mechanism T**1** places this wafer W on the receiver $PASS_{1B}$ (step S**22**), and holds the wafer W present on the receiver $PASS_{1A}$ with the other holding arm **57** (e.g. **57***a*).

The main transport mechanism T_1 accesses a predetermined one of the cooling units CP_1. There is a different wafer W having already received a predetermined heat treatment (cooling) in the cooling unit CP_1. The main transport mechanism T_1 holds the different wafer W with the unloaded holding arm **57** (holding no wafer W), takes it out of the cooling unit CP_1, and loads into the cooling unit CP_1 the wafer W having received from the receiver $PASS_{1A}$. Then, the main transport mechanism T_1, holding the cooled wafer W, moves to one of the antireflection film coating units $BARC_1$. The cooling unit CP_1 starts heat treatment (cooling) of the wafer W loaded therein (step S**2**). It is assumed that, when the main transport mechanism T_1 subsequently accesses the different heat-treating units **41** and coating units **31**, wafers W having received predetermined treatments are present in these treating units (**31** and **41**).

Accessing the antireflection film coating unit $BARC_1$, the main transport mechanism T_1 takes a wafer W having antireflection film formed thereon from the antireflection film coating unit $BARC_1$, and places the cooled wafer W on the spin holder **32** of the antireflection film coating unit $BARC_1$. Then, the main transport mechanism T_1, holding the wafer W having antireflection film formed thereon, moves to one of the heating and cooling units PHP_1. The antireflection film coating unit $BARC_1$ starts treatment of the wafer W placed on the spin holder **32** (step S**3**).

Specifically, the spin holder **32** spins the wafer W in horizontal posture, the gripper **26** grips one of the nozzles **35**, the nozzle moving mechanism **37** moves the gripped nozzle **35** to a position above the wafer W, and the treating solution for antireflection films is supplied from the nozzle **35** to the wafer W. The treating solution supplied spreads all over the wafer W, and is scattered away from the wafer W. The cup **33** collects the scattering treating solution. In this way, the treatment is carried out for forming antireflection film on the wafer W.

Accessing the heating and cooling unit PHP_1, the main transport mechanism T_1 takes a wafer W having received heat treatment out of the heating and cooling unit PHP_1, and loads the wafer W having antireflection film formed thereon into the heating and cooling unit PHP_1. Then, the main transport mechanism T_1, holding the wafer W taken out of the heating and cooling unit PHP_1, moves to one of the cooling units CP_1. The heating and cooling unit PHP_1 receives a wafer W successively on the two plates **43**, to heat the wafer W on one of the plates **43** and then to cool the wafer W on the other plate **43** (step S**4**).

Having moved to the cooling unit CP_1, the main transport mechanism T_1 takes a wafer W out of the cooling unit CP_1, and loads the wafer W held by the transport mechanism T_1 into the cooling unit CP_1. The cooling unit CP_1 cools the wafer W loaded therein (step S**5**).

Then, the main transport mechanism T_1 moves to one of the resist film coating units $RESIST_1$. The main transport mechanism T_1 takes a wafer W having resist film formed thereon from the resist film coating unit $RESIST_1$, and loads the wafer W held by the main transport mechanism T_1 into the resist film coating unit $RESIST_1$. The resist film coating unit $RESIST_1$ supplies the resist film material while spinning the wafer W loaded therein, to form resist film on the wafer W (step S**6**).

The main transport mechanism T_1 further moves to one of the heating and cooling units PHP_1 and one of the cooling units CP_1. The main transport mechanism T_1 loads the wafer W having resist film formed thereon into the heating and cooling unit PHP_1, transfers a wafer W treated in the heating and cooling unit PHP_1 to the cooling unit CP_1, and receives a wafer W treated in the cooling unit CP_1. The heating and cooling unit PHP_1 and cooling unit CP_1 carry out predetermined treatments of newly loaded wafers W, respectively (steps S**7** and S**8**).

The main transport mechanism T_1 moves to the receiver $PASS_2$, places the wafer W it is holding on the receiver $PASS_{2A}$ (step S**9**), and receives a wafer W present on the receiver $PASS_{2B}$ (step S**21**).

Subsequently, the main transport mechanism T_1 accesses the receiver $PASS_1$ again, and repeats the above operation. This operation is controlled by the second controller **94**. Having received a wafer W from the receiver $PASS_1$, the main transport mechanism T_1 transports this wafer W to a predetermined treating unit (a cooling unit CP_1 in this embodiment), and takes a treated wafer W from this treating unit. Subsequently, the main transport mechanism T_1 moves to a plurality of treating units in order, and transfers wafers W treated in the respective treating units to other treating units. Whenever a treated wafer W is replaced by a wafer W to be treated, each treating unit (**31**, **41**) starts the predetermined treatment. Thus, predetermined treatments are carried out in parallel for a plurality of wafers W in the respective treating units. A series of treating steps is successively performed for a plurality of wafers W. In these circumstances, the second controller **94** controls periods of the series of treating steps to be uniform. Further, it is preferred to control the timing of transporting wafers W to each treating unit (**31**, **41**) and a schedule of treatment carried out in each treating unit (**31**, **41**) to be uniform between the wafers W. As a result, the series of treatments is completed in order, starting with a wafer W first placed on the receiver $PASS_1$. The wafers W are forwarded to the receiver $PASS_2$ in the order in which they are placed on the receiver $PASS_1$. Similarly, the main transport mechanism T_1 places the wafers W on the receiver $PASS_1$ in the order of receipt from the receiver $PASS_2$.

[Main Transport Mechanisms T_2, T_4]

Since operation of the main transport mechanism T_4 is substantially the same as operation of the main transport mechanism T_2, only the main transport mechanism T_2 will be described. The main transport mechanism T_2 moves to a position opposed to the receiver $PASS_2$. At this time, the main transport mechanism T_2 holds a wafer W received from a cooling unit CP_2 accessed immediately before. The main transport mechanism T_2 places this wafer W on the receiver $PASS_{2B}$ (step S**21**), and holds the wafer W present on the receiver $PASS_{2A}$ (step S**9**).

The main transport mechanism T_2 accesses the edge exposing unit EEW_2. The main transport mechanism T_2 receives a wafer W having received a predetermined treatment in the edge exposing unit EEW_2, and loads the cooled wafer W into the edge exposing unit EEW_2. While spinning the wafer W loaded therein, the edge exposing unit EEW_2 irradiates peripheral regions of the wafer W with light from the light emitter not shown, thereby exposing the peripheral regions of the wafer W (step S**10**).

The main transport mechanism T_2, holding the wafer W received from the edge exposing unit EEW_2, accesses the receiver $PASS_5$. The main transport mechanism T_2 places the wafer W on the receiver $PASS_{5A}$ (step S**11**), and holds a wafer W present on the receiver $PASS_{5B}$ (step S**16**).

The main transport mechanism T_2 moves to one of the cooling units CP_2, and replaces a wafer W in the cooling unit CP_2 with the wafer W held by the main transport mechanism T_2. The main transport mechanism T_2 holds the wafer W having received cooling treatment, and accesses one of the developing units DEV_2. The cooling unit CP_2 starts treatment of the newly loaded wafer W (step S**17**).

The main transport mechanism T_2 takes a developed wafer W from the developing unit DEV_2, and places the cooled wafer W on the spin holder **77** of the developing unit DEV_2. The developing unit DEV_2 develops the wafer W placed on the spin holder **77** (step S**18**). Specifically, while the spin holder **77** spins the wafer W in horizontal posture, the developer is supplied from one of the slit nozzles **81***a* to the wafer W, thereby developing the wafer W.

The main transport mechanism T_2 holds the developed wafer W, and accesses one of the heating units HP_2. The main transport mechanism T_2 takes a wafer W out of the heating unit HP_2, and loads the wafer W it is holding into the heating unit HP_2. Then, the main transport mechanism T_2 transports the wafer W taken out of the heating unit HP_2 to one of the cooling units CP_2, and takes out a wafer W already treated in this cooling unit CP_2. The heating unit HP_2 and cooling unit CP_2 carry out predetermined treatments for the newly loaded wafers W, respectively (steps S**19** and S**20**).

Subsequently, the main transport mechanism T_2 accesses the receiver $PASS_2$ again, and repeats the above operation. This operation is controlled by the third controller **95**. As a result, the wafers W are forwarded to the receiver $PASS_{5B}$ in the order in which they are placed on the receiver $PASS_{2A}$. Similarly, the wafers W are forwarded to the receiver $PASS_{SB}$ in the order in which they are placed on the receiver $PASS_{5B}$.

[IF's Transport Mechanisms T_{IF}—First Transport Mechanism T_{IFA}]

The first transport mechanism T_{IFA} accesses the receiver PAS S_5, and receives the wafer W present on the receiver $PASS_{5A}$ (step S**11***a*). The first transport mechanism T_{IFA}, holding the wafer W received, moves to the receiver PASS-CP, and loads the wafer W on the receiver PASS-CP (step S**12**).

Next, the first transport mechanism T_{IFA} receives a wafer W from the receiver $PASS_7$ (step S**14**), and moves to a position opposed to one of the heating and cooling units PHP_2. The first transport mechanism T_{IFA} takes a wafer W having received heat treatment (PEB: Post Exposure Bake) from the heating and cooling unit PHP_2, and loads the wafer W received from the receiver PASS**7** into the heating and cooling unit PHP_2. The heating and cooling unit PHP_2 carries out heat treatment for the newly loaded wafer W (step S**15**).

The first transport mechanism T_{IFA} transports the wafer W taken out of the heating and cooling unit PHP_2 to the receiver $PASS_{5B}$. Subsequently, the first transport mechanism T_{IFA} transports a wafer W from the receiver $PASS_{6A}$ to the receiver PASS-CP (Step S**11***b*, **12**). Next, the first transport mechanism T_{IFA} transports a wafer W from the receiver $PASS_7$ to one of the heating and cooling units PHP_4. At this time, the first transport mechanism T_{IFA} takes out a wafer W having been treated in the heating and cooling unit PHP_4, and places the wafer W on the receiver $PASS_{6B}$.

Subsequently, the first transport mechanism T_{IFA} accesses the receiver $PASS_5$ again and repeats the above operation. This operation is controlled by the sixth controller **98**. By transporting wafers W alternately from the receivers $PASS_5$ and $PASS_6$ to the receiver PASS-CP, the wafers W are placed on the receiver PASS-CP in the order in which the ID's transport mechanism TID has taken them out of the cassette C.

However, the controls of transport to and from the treating units by the main transport mechanisms T and treatment in the treating units are carried out independently for each of the cells **11**-**14**. That is, no adjustment is made to the timing of feeding wafers W to each of the receiver $PASS_5$ and receiver $PASS_6$. Therefore, the order of feeding wafers W to the receiver $PASS_5$ and receiver $PASS_6$ may not agree with the order in which they are taken out of the cassette C due to a fault such as a delay in substrate treatment or transportation. In such a case, the sixth controller **98** operates the first transport mechanism T_{IFA} as follows.

When wafers W fail to be fed to either one of the receiver $PASS_{5A}$ and receiver $PASS_{6A}$, and wafers W are placed on the other receiver, the wafers W placed on the other receiver is transported to the buffers BF instead of the receiver PASS-CP. When wafers W begin to be placed again on the receiver for which the feeding has been disrupted, the wafers W are transported from the receiver now restored to service to the receiver PASS-CP, and also from the buffers BF to the receiver PASS-CP. At this time, the wafers W are transported alternately from the restored receiver and buffers BF to the receiver PASS-CP. As a result, even when the order of feeding wafers W to the receiver $PASS_5$ and receiver $PASS_6$ disagrees with the order in which they are taken out of the cassette C, the order of wafers W transported to the receiver PASS-CP is in agreement with the order of wafers W taken out of the cassette C.

[IF's Transport Mechanisms T_{IF}—Second Transport Mechanism T_{IFB}]

The second transport mechanism T_{IFB} takes a wafer W out of the receiver PASS-CP, and transports it to the exposing machine EXP. Then, the second transport mechanism T_{IFB} receives an exposed wafer W from the exposing machine EXP, and transports it to the receiver $PASS_7$.

Subsequently, the second transport mechanism T_{IFB} accesses the receiver PASS-CP again and repeats the above operation. This operation also is controlled by the sixth controller **98**. As described above, the first and second transport mechanisms T_{IFA} and T_{IFB} cooperate to feed wafers W to the exposing machine EXP in the order in which they are taken out of the cassette C.

The substrate treating apparatus according to this embodiment has two substrate treatment lines Lu and Ld arranged one over the other. This construction can substantially double the processing capabilities in the treatment for forming anti-reflection film and resist film and in the treatment for developing wafers W. Therefore, the throughput of the substrate treating apparatus is improved drastically.

Each of the substrate treatment lines Lu and Ld includes the main transport mechanisms T arranged in one row. This arrangement can inhibit an increase in the installation area of the treating section **3**.

The arrangements of the main transport mechanisms T_1 and T_3 (T_2 and T_4) and treating units in the two, upper and lower, substrate treatment lines Lu (Ld) are substantially the same in plan view, which can simplify the construction of the apparatus.

The construction of the apparatus may be simplified by providing the same type of treating units for the two, upper and lower, substrate treatment lines Lu and Ld to perform the same series of treatments.

The treating units of the upper and lower cells **11** and **13** (**12**, **14**) are stacked together. This arrangement can simplify the construction of treating blocks Ba and Bb each including two, upper and lower cells.

Each of the treating blocks Ba and Bb has a housing **75** which collectively supports the two, upper and lower, main transport mechanisms T and the plurality of treating units. This allows the substrate treating apparatus to be manufactured efficiently and to be maintained and repaired easily.

Each of the transporting spaces A_1-A_4 has the first blowout openings **61***a* and discharge openings **62***a*, which can keep each transporting space A clean.

The first blowout openings **61***a* are arranged over each transporting space A, and the discharge openings **62***a* under each transporting space A, to produce substantially vertical, downward gas currents in the transporting space A. This prevents the temperature environment of transporting spaces

A, coating units **31** and developing units DEV from being influenced by the heat from the heat-treating units **41**.

The exhaust unit **62** provided in the transporting space A_1 (A_2) and the first blowout unit **61** provided in the transporting space A_3 (A_4) block off the atmospheres of each of the transporting spaces A_1 and A_3 (A_2 and A_4). Thus, each transporting space A can be maintained clean. The apparatus construction is simplified since no special or additional component is required for blocking off atmosphere.

The first gas supply pipe **61** is provided as a component common to the first blowout units **61** of the upper and lower transporting spaces A_1 and A_3. This reduces piping installation space and simplifies the apparatus construction.

The receivers $PASS_1$ and $PASS_3$ are provided for transferring wafers W between the ID's transport mechanism T_{ID} and main transport mechanisms T_1 and T_3, which can prevent lowering of the transporting efficiency of the ID's transport mechanism T_{ID} and main transport mechanisms T_1 and T_3. Similarly, the transporting efficiency of each transport mechanism is prevented from lowering by transferring wafers W between the transport mechanisms through the receivers PASS.

Since the receiver $PASS_1$ and receiver $PASS_3$ are locate close to each other, the ID's transport mechanism T_{ID} can access the receiver $PASS_1$ and receiver $PASS_3$ through a reduced amount of vertical movement.

The main controller **91** and the first to sixth controllers **93-98** are provided to control movement of wafers W to bring into agreement the order of fetching from a cassette C and the order of feeding to the exposing machine EXP. This enables supervision or follow-up check of each wafer W without providing a construction for identifying the wafers W.

The common, second gas supply pipe **65** is provided for the coating units **31** (developing units DEV) in the upper and lower cells **11** and **13** (**12** and **14**). This reduces piping installation space and simplifies the apparatus construction.

This invention is not limited to the foregoing embodiment, but may be modified as follows:

(1) The foregoing embodiment provides two substrate treatment lines Lu and Ld, but the invention not limited to this. The construction may be modified to include three or more substrate treatment lines vertically arranged in multiple stages.

(2) In the foregoing embodiment, each substrate treatment line Lu (Ld) has two cells **11** and **12** (**13** and **14**) connected to each other. The invention is not limited to this. Each substrate treatment line may have three or more cells.

(3) In the foregoing embodiment, the substrate treatment lines Lu and Ld carry out the treatment for forming resist film and antireflection film on the wafers W, and the treatment for developing exposed wafers W. The substrate treatment lines may be modified to perform other treatment such as cleaning of the wafers W. Accordingly, the type, number and the like of treating units are selected or designed as appropriate. Further, the substrate treating apparatus may be constructed to exclude the IF section **5**.

(4) In the foregoing embodiment, the two substrate treatment lines Lu and Ld perform the same series of treatments. Instead, the substrate treatment lines Lu and Ld may be modified to perform different treatments.

(5) In the foregoing embodiment, the two substrate treatment lines Lu and LD have substantially the same plane layout. Instead, each of the substrate treatment lines Lu and Ld (i.e. upper and lower cells) may have the main transport mechanisms T and treating units arranged differently.

(6) In the foregoing embodiment, the upper and lower cells **11** and **13** (**12** and **14**) have the same arrangement of treating units as seen from the main transport mechanisms T. Instead, the upper and lower cells may have different arrangements of treating cells.

(7) In the foregoing embodiment, each of the cells **11-14** has the treating units arranged at opposite sides of the transporting space A. Instead, the treating units may be arranged at only one side.

(8) In the foregoing embodiment, wafers W are transferred between the transport mechanisms through the receivers PASS. Instead, the wafers W may be transferred directly between the transport mechanisms, for example.

(9) The foregoing embodiment may be modified to include buffers BF and cooling units CP arranged over and/or under the receivers $PASS_1$, $PASS_2$, $PASS_3$ and $PASS_4$. This construction allows the wafers W to be stored temporarily or cooled as appropriate.

(10) In the foregoing embodiment, the IF transport mechanisms TIF include two transport mechanisms TIFA and TIFB. The IF section may be modified to include one transport mechanism or three or more transport mechanisms.

(11) The foregoing embodiment provides no partition or the like between the antireflection film coating unit BARC and resist film coating unit RESIST, but allows the atmosphere to be shared between these coating units. Instead, the atmospheres of the two units may be blocked off as appropriate.

(12) In the foregoing embodiment, one first blowout unit **61** and one exhaust unit **62** are constructed to block off the atmosphere of each of the transporting spaces A_1 and A_3 (A_2 and A_4). The invention is not limited to this. For example, only one of the first blowout unit **61** and exhaust unit **62** may block off atmosphere. Alternatively, a shielding plate may be provided separately from the first blowout unit **61** and exhaust unit **62** for blocking off the atmosphere of each of the upper and lower transporting spaces A.

(13) In the foregoing embodiment, the first blowout unit **61** is disposed over each transporting space A, and the exhaust unit **62** disposed under each transporting space. Instead, the first blowout unit **61** or exhaust unit **62** may be disposed laterally of each transporting space A. The first blowout unit **61** and exhaust unit **62** may be shared by the transporting spaces A_1 and A_2 (A_3 and A_4) of the same substrate treatment line Lu (Ld).

This invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification, as indicating the scope of the invention.

What is claimed is:

1. A substrate treating method for treating substrates with a substrate treating apparatus having an indexer section, a treating section and an interface section, the method comprising the steps of:

- performing resist film forming treatment in parallel on at least two of a plurality of stories provided in the treating section, wherein the treating section includes the plurality of stories arranged vertically, each story having:
  - treating units for treating substrates, and
  - a main transport mechanism for transporting the substrates to the treating units on each story; and
- performing developing treatment in parallel on at least two of the plurality of stories provided in the treating section;
- a step executed in the interface section of receiving the substrates alternately from the respective stories on which the resist film forming treatment is performed, and transporting the substrates to an exposing machine provided as external apparatus; and

a step executed in the interface section of receiving the substrates from the exposing machine, and transporting the substrates alternately to the respective stories on which the developing treatment is performed;

wherein the step of transporting the substrates to the exposing machine is realized by an interface's transport mechanism provided for the interface section to repeat, while changing the stories from which the substrates are received, an operation to receive one substrate from one of the stories and transport the substrate to the exposing machine;

the step of transporting the substrates alternately to the respective stories is realized by the interface's transport mechanism to repeat, while changing the stories to which the substrates are transported, an operation to receive one substrate from the exposing machine and transport the substrate to one of the stories; and

the step of transporting the substrates to the exposing machine is executed to transport the substrates to the exposing machine in an order in which the substrates are taken out of a cassette placed on a cassette table provided for the indexer section.

2. The substrate treating method of claim **1**, comprising the step executed in the indexer section of taking the substrates out of a cassette placed on the cassette table and transporting the substrates alternately to the respective stories on which the resist film forming treatment is performed;

the step of transporting the substrates alternately to the respective stories being realized by an indexer's transport mechanism provided for the indexer section to repeat, while changing the stories to which the substrates are transported, an operation to take one substrate out of the cassette and transport the substrate to one of the stories.

3. The substrate treating method of claim **1**, comprising the step executed in the indexer section of receiving the substrates alternately from the respective stories on which the developing treatment is performed, and storing the substrates in a cassette;

the step of storing the substrates in the cassette being realized by an indexer's transport mechanism provided for the indexer section to repeat, while changing the stories from which the substrates are received, an operation to receive one substrate from one of the stories and store the substrate in the cassette.

4. The substrate treating method of claim **1**;

wherein both the step of performing the resist film forming treatment and the step of performing the developing treatment are executed on each of the stories;

the method further comprising the step executed in the indexer section of taking substrates out of a cassette, transporting the taken-out substrates alternately to the respective stories, and when transporting the substrates to the respective stories, receiving substrates alternately from the respective stories, and storing the received substrates in the cassette;

the step being realized by an indexer's transport mechanism provided for the indexer section to repeat, while changing the stories, an operation to store one substrate in the cassette, take one substrate out of the cassette, transport the substrate to one of the stories, and receive one substrate from the one of the stories.

5. The substrate treating method of claim **1**,

wherein the step of transporting the substrates to the exposing machine is executed to transport the substrates received from the respective stories on which the resist film forming treatment is performed to the exposing machine, instead of storing the substrates in the cassette placed on the cassette table provided for the indexer section.

6. The substrate treating method of claim **1**,

wherein the step of transporting the substrates alternately to the respective stories is executed to transport the substrates received from the exposing machine to the respective stories on which the developing treatment is performed, instead of storing the substrates in the cassette placed on the cassette table provided for the indexer section.

7. The substrate treating method of claim **1**;

wherein both the step of performing the resist film forming treatment and the step of performing the developing treatment are executed on each of the stories;

the method further comprising the step executed in the interface section of receiving the substrates alternately from the respective stories, transporting the substrates to an exposing machine provided as external apparatus, receiving the substrates from the exposing machine, transporting the substrates to the respective stories, and when transporting the substrates to the respective stories, receiving the substrates from the respective stories;

the step being realized by an interface's transport mechanism provided for the interface section to repeat, while changing the stories, an operation to transport one substrate to one of the stories, receive one substrate from the one of the stories, transport the substrate the exposing machine, and receive one substrate from the exposing machine.

8. The substrate treating method of claim **1** wherein each of the stories for performing the resist film forming treatment of the substrates feeds the substrates to the interface section in an order in which the substrates are received from the indexer section.

9. The substrate treating method of claim **1** wherein each of the stories for performing the developing treatment of the substrates feeds the substrates to the indexer section in an order in which the substrates are received from the interface section.

10. The substrate treating method of claim **1** wherein controls for causing the respective stories to perform the resist film forming treatment of the substrates are independent of each other.

11. The substrate treating method of claim **1** wherein controls for causing the respective stories to perform the developing treatment of the substrates are independent of each other.

12. The substrate treating method of claim **1** wherein the step of performing the resist film forming treatment in parallel is executed to carry out a series of treating steps successively for the substrates, which treating steps include treatment for applying a resist film material to the substrates and treatment for heat-treating the substrates, periods of the series of treating steps being uniformed for the respective substrates.

13. The substrate treating method of claim **1**, comprising:

the step executed in the indexer section of taking the substrates out of a cassette, and transporting the substrates to the respective stories on which the resist film forming treatment is performed; and

the step executed in the interface section of receiving the substrates from the respective stories on which the resist film forming treatment is performed, and transporting the substrates to an exposing machine provided as external apparatus.

14. The substrate treating method of claim **13** wherein, when a difference occurs between the order of the substrates received by the interface section from the stories on which the resist film forming treatment is performed, and the order of the substrates taken out of the cassette in the indexer section, the substrates are placed on buffers to enable the interface section to receive succeeding substrates from the respective stories on which the resist film forming treatment is performed.

15. The substrate treating method of claim **13** wherein, when the substrates fail to be fed to the interface section from part of the stories on which the resist film forming treatment is performed and the substrates are fed to the interface section from other of the stories, the interface section transports the substrates fed from the other of the stories to the buffers.

16. The substrate treating method of claim **15** wherein, when the substrates begin to be fed again from the part of the stories having stopped feeding the substrates, the interface section transports the substrates fed from the part of the stories and the substrates placed on the buffers, alternately to the exposing machine.

17. The substrate treating method of claim **1**, wherein the main transport mechanism of each story is confined to the story thereof and not shared in adjacent stories.

18. The substrate treating method of claim **1**, wherein the treating section includes a shielding plate disposed between the respective stories.

19. The substrate treating method of claim **1**, wherein:

the indexer section transports the substrates between the treating section and a cassette; and

the interface section transports the substrates between the treating section and an exposing machine provided as external apparatus.

* * * * *